THE

# ELECTRICAL REVIEW.

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## ELECTRICAL REVIEW.

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**THE UNIVERSAL ELECTRICAL DIRECTORY**

(J. A. Berly's).

**1914 EDITION**

READY IN A FEW DAYS.

*H. Alabaster, Gatehouse & Co., 4, Ludgate Hill, London, E.C.*

## LORD CLAUD HAMILTON AND RAILWAY MANAGEMENT.

THE appointment of an American manager to a great English railway would be likely, in any event, to be the subject of some comment, but the remarks of Lord Claud Hamilton at the meeting of the Great Eastern Railway Co., on Friday last, widen the scope of the comment considerably. Mr. Thornton, as manager of the Long Island Railway Co., has, according to Lord Claud, operated the chief suburban system in the United States. It was worked by electricity, and it was most desirable that the Great Eastern should have a general manager who thoroughly understood the principles of electricity and the working of railways by that method. As an indication of the intention of the Great Eastern Co. to utilise electrical methods and to acquire the benefit of the widest experience, this statement should be regarded as eminently satisfactory. The board expect criticism of their appointment, and Lord Claud replied by anticipation to some such criticisms. And here his mistake became apparent. Never was there a clearer example of the truth of the proverb "Qui s'excuse s'accuse." He had to look abroad because there was, he said, an acknowledged dearth of first-class men coming to the front in the railway world at home, not alone for those capable of acting as general manager, but for even the minor appointments. No word indicating that the head of a great undertaking appreciated the obligation, which is regarded as elementary in most enterprises, that there should be every encouragement for the most suitable men in the line of succession to all appointments! Lord Claud was on safer ground when he expressed the fear that there had grown up with us a tendency to sacrifice merit at the expense of seniority; but, surely, to break away from such a system it is not necessary to import the merit! From further remarks we must be led to question whether the chairman of an English railway knows whether any merit is available or not. The departments, he said, were kept so apart that there was little interchange of young men from one to another, thus removing any incentive to new ideas or methods. In the United States, on the other hand, the president and general manager knew every rising young man in their employ, because the young men were interchangeable from one department to another, and when this interchangement took effect the man at headquarters knew about it, "and their names were entered on his list." A re-arrangement in this direction, he thought, was required without delay. With such a sign of grace it may seem ungenerous to ask who arranged and continued the water-tight compartment system which stifles enterprise and suppresses merit. Was it the unfortunate victims of youthful age and comparatively subordinate position or their elders in the board room?

Now, the appointment of any officer of the Great Eastern Railway is a domestic matter. The directors have a responsibility, and upon the results they will be judged. The pity is that in making this announcement, the

chairman should have taken the opportunity of uttering remarks which will unquestionably give rise to much misapprehension. We shall without doubt have a recrudescence of the depreciatory reflections from which we thought we were happily emerging. Our American cousins other than President Wilson, suffering traders, and unfortunate investors may run some risk of forming the conclusion that all their railway enterprises are perfection in management and financial returns. Let us at once bring the matter to a more accurate focus by remarking that one chairman must not be regarded as representative of Britain, or one manager as representative of America. We may also recall that not long since a prominent employer of labour in the United States deplored, just as does Lord Claud here, the dearth of talent for important posts there. He did not, however, include minor appointments, and his remarks were perhaps more general and less reflective on a particular class of workers.

Like all converts who have pondered over their new creed for so long as a fortnight, Lord Claud Hamilton is enthusiastic, and Mr. Thornton would lack a very necessary qualification for his appointment if his examination of the problem over a similar period did not inspire him with complete confidence. The problem is, of course, much deeper. A manager may contribute materially to the success of an undertaking under one set of circumstances with which he is familiar, and be less successful under changed conditions. It is possible, for example, that a manager in the United States may not have acquired a knowledge of the watertight-compartment system which differentiates the respective importance of the manager and chairman on an English railway. This was defined by Lord Claud Hamilton, and published by the Press Association in the evening of the day on which the new appointment was published in the morning. An announcement had been made that the railway companies had decided to accord recognition to the National Union of Railwaymen. This was denied by Lord Claud Hamilton in the following words:—"The question of recognition has never been discussed by the companies. The general managers have met and discussed the matter, but the general managers are not the companies, and the chairmen have never talked the subject over together. The statement, therefore, that recognition of the Union has been decided upon by the companies is perfectly untrue." If, by any chance, it should be customary in the United States to consider that subjects discussed by general managers have been discussed by the companies, the new general manager of the Great Eastern will have to learn a new code of etiquette. But such matters as these are internal, and easily acquired. There are others which are external, and not easily absorbed even by very capable men trained in other spheres. The general idea that administrative reforms are best carried out by new men is open to serious question, and this applies with especial force when the reformer is necessarily unacquainted with the ideas and aspirations (or lack of aspirations) of those for whom the reforms are initiated, and by whom they are to be carried out. This, however, is in the nature of a criticism of the appointment, which is less our intention than to enter a protest against the general tendency of Lord Claud Hamilton's remarks. A cordial welcome should be extended to any one who is expected to improve our facilities for travel, develop the discovery and encouragement of merit, or add even a fraction to dividends. And regret should also be expressed that the new manager's difficult task should be rendered the more difficult by the comments of his maladroit patron.

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**The Railway Electrification Problem.**

Mr. Roger Smith's paper on railway conditions governing electrification, read before the I.E.E. on Thursday last week, introduces a topic of very great interest at a time when railway electrification is so much in evidence.

The British railway authorities have been both the hope and the despair of the electrical engineer in the past, partly because no obstacle has seemed too small to hinder the adoption of electric traction, and the most trifling improvement in steam traction, has served as a pretext for delay.

Generally speaking, the author appears to favour suburban electrification, although he says: "it is very doubtful if electrification is the only solution of the congested-traffic problem"; he evidently considers that the steam locomotive will continue to haul main-line trains for some time to come—for one reason, because a suitable electric locomotive has not yet been built—but he apparently believes that goods haulage is practicable and, if the North-Eastern experiment turns out successfully, a matter of the near future.

We value the paper because the author's inside knowledge of the working of a great railway is tempered by exceptional knowledge of the electric traction problem. His statement that many lines had been electrified before they had come to the end of their tether under steam traction can be taken as an admission of the superior possibilities of electric traction.

The author considers that the Brighton main-line electrification may be justified in view of the traffic conditions, but that this would not be so where passenger traffic was a small percentage of the total. Surely this is a somewhat paradoxical conclusion, in view of his evident belief that goods traffic could be dealt with electrically, for where passenger traffic is a small percentage of the total, goods traffic is presumably a large one and will bear its share of the cost of line equipment.

If we take the author's admissions in regard to electrification and couple them with the necessity, for financial reasons, of electrifying congested terminals in the near future and routes which are physically impossible of improvement by steam traction, we may almost assume that general electrification is not so far distant as is often believed. After all, what the railways urgently want is increased earning capacity, which electric traction can give them, and steam traction cannot give them, except on prohibitive terms.

We give place to none in our admiration for the sound engineering associated with British railway working, but railway electrification has, to a large extent, ceased to be an engineering question, and we may be permitted to doubt whether economics has had as much to do with its apparently slow progress in this country as tradition.

It is difficult to appreciate the railway point of view; Mr. Smith, for instance, says: "It is far easier to change things than to change the habits and inherited instincts of large bodies of men, and electrical engineers have not only to show railway managers that they can haul the railway traffic either better or more cheaply than is done to-day by steam, but that they can first of all haul traffic at least as well as it is hauled by steam and fulfil most if not all the functions of the steam locomotive in the manner to which those who work the traffic have been accustomed." It will be seen that the onus of proof is cast upon the electrical engineer; he must not only prove his case, but prove it along traditional steam lines. One might almost suppose that he was bolstering up an untried, unsound proposition, and that an indifferent railway management, with really nothing to gain by its adoption, was seeking the least troublesome way to avoid his unwelcome attentions.

We would suggest that the electrical engineer has shown his ability to better steam traffic conditions in very many instances, and that the real question is how to alter older methods of railway working, which present-day requirements are rendering more and more unremunerative, and adapt them to suit electric traction.

That this is a difficult matter under the present railway system will be granted, but it is nevertheless probable that existing conditions, which have led to the state of affairs outlined by Lord Claud Hamilton, in announcing the appointment of an American manager to the Great Eastern Railway, who has incidentally been in control of the largest suburban electric railway service in the United States, may have even greater influence on our railway electrification problem than those so ably outlined by Mr. Roger Smith last week.

**The Lead Position.**

The general position in the lead market remains pretty much as before, but there has been a decided abatement in the demand for early deliveries, which in conjunction with a more accommodating attitude on the part of the Convention brokers has resulted in an easing down of the stringency which has been an intermittent feature in the situation for so long. There has not been any sign of an increase in the quantities of metal coming to hand from abroad, and everything reaching here passes into consumption without difficulty, while immediate delivery lead is, as hitherto, held as a premium. On the whole, rather less general speculative interest has been shown in the market, the transactions recorded openly being decidedly smaller in volume than for some little while. There is still a fair oversold quantity for March and April shipment, and this may result in firmer prices when it becomes necessary to adjust the short account. One feature of rather special importance which has cropped up lately, has been the shipment of uncontrolled lead from New York to London. The business was entirely unexpected by the market at large, and it seems as if the controlling influences had decided in some measure to change their policy, following upon sales for export of uncontrolled material. In any event, since this particular lead arrived the price has never since been at a level at which outside producers could supply material to the European market, and it is quite possible that efforts will be made to prevent values rising to this pitch again except, possibly, for a short time only. Another point in the market is the recent sale of several hundred tons of lead for prompt shipment from Belgium to London, which is also an unusual feature; but, in spite of this, there has not been any excess of material available for delivery, and no evidence is to be obtained of any material alteration in the broad outlines of the position. While the home trade has been rather dull, there is still a lack of material in the hands of consumers, and Russian demands have been in evidence from time to time. The Continental buying, however, has been of a rather fitful nature, and dealers in London have on a good many occasions found themselves rather sharply undersold by leading Continental interests closely allied with the Convention. The reports from Mexico have lately been rather more reassuring so far as the resumption of industrial operations in the northern part of the country is concerned, but there is no assurance that any substantial progress has been made towards the restoration of normal conditions in respect to the production of lead available for export. Mail advices report that some of the lead furnaces have been put to work again, but railroad communications are very much hampered, and fresh destruction of permanent way material has been in progress. Indications as regards the market generally point to a continuance of moderately high prices until there is some radical change in the mutual relations between supply and demand. The January imports amounted to 15,540 tons, compared with 21,159 tons in January, 1913, and 14,095 tons in January, 1912, while the exports last month were 6,603 tons, compared with 5,584 tons a year ago and 3,572 tons in 1912.

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**Electrical Labour Disputes.**

According to a report in a Manchester newspaper, the members of the Electrical Trades Union are refusing to accept an alteration in the District Rules relating to non-Union workers. They resent an attempt that is "being made to introduce into the electrical trades in Manchester the rule of the London Master Builders' Federation, which stipulates that Unionists shall work with non-Union men." Their attitude may be represented by the following statement:—"If the masters try that sort of thing . . . . there will be trouble." If this is still the policy of the electrical workers, they are certainly not paving the way for a settlement of disputes. Our own belief is that it is the battle-cry of the leaders rather than the opinion of the men themselves. As a matter of fact, however, the working rules of the Manchester, Salford and District Building Trades Federation, which have been accepted and observed for a number of years, have contained a rule that "Whilst agreeing not to place any obstacle in the way of men joining the Wiremen's Union, the masters do not agree to employ Union men only." The above version of the position is therefore nothing short of a gross misrepresentation. What the masters of Manchester desire to do is to substitute the following rule which is more generally adopted throughout the building trades:—

> **No strike or lock-out to take place under any circumstances until the matter in dispute has first been referred to a joint committee of employers and operatives who shall meet within six days and endeavour to settle. Should they fail, the same shall be referred to an umpire to be mutually agreed upon by the said committee.**

If the Manchester Unionist workers are serious in their suggestion that no non-Unionist shall follow his calling in their own choice company, they will require to be brought to their senses somehow. It practically amounts to saying that an employer is only to be permitted to engage an electrical workman if he is a member of the Union, and without any assurance as to fitness or efficiency! His non-Union workmen, if he employs both kinds, may only work on a job by themselves. How utterly unworkable, and, indeed, impossible of acceptance, such a proposition is, surely the most simple-minded man can see. We are more than ever convinced that it is sane leadership that the electrical workers require, leadership that will remind them of a few of the most elementary principles of business and common justice. It is not for the employers anywhere to force men into the Unions. It is for the Unions so to impress the workers with the benefits of membership, and so to inspire confidence and respect in their organisations, that they shall be induced to sacrifice their freedom. If they are unable to do that—and we believe that the Unions will lose rather than gain members in the long run if they continue the policy of intolerance—then they must be content for there to be two classes of workers, and must recognise that the unorganised worker is as much a man as themselves, and has equal rights to work and to protection in the course of his employment. All this is very elementary, we know, but elementary matters seem to be overlooked by the worker when listening to the wild propaganda talk of irresponsible agitators.

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**The German Electrical Industry in 1913.**

The Association of Special Electrical Works, representing makers who are independent of the few large firms, reports that 1913 was in general favourable for the special works. During the first half of the year they experienced a further expansion in the turnover as compared with the corresponding period in 1912, but toward the end of the year a slackening was manifested, which is attributed to the general economic depression, the particularly unfortunate conditions in the building trades, and the reserve shown by local authorities in the extension of their supply works owing to the monetary stringency. On the other hand, a favourable influence on the degree of activity was exercised by the expansion of overland central stations free from monopolistic control, and by the further advance in the application of electricity to agriculture, trade, and domestic purposes. The centre of business gravity lay in the home market; the export trade also increased, although, to some extent, it can only be maintained by making sacrifices. By way of explanation of this statement it is mentioned that the export trade with Austria, Russia, France, Italy, and Switzerland is becoming more difficult day by day in consequence of the increasing development of the native industries of these countries under the protection of high import duties.

The report remarks further that the labour conditions in Germany in 1913 were satisfactory, and no strikes or lock-outs were recorded. The supply of skilled and unskilled workers was good, although there was a continued scarcity of really qualified mechanics for delicate work.

The rates of wages underwent a further increase over those of the preceding year. As far as the sale prices of electrical

manufactures are concerned, the report states that they were mostly unsatisfactory in so far as the products were not controlled by trade syndicates; and it was no longer possible fully to maintain the additions which were made to prices in various branches at the beginning of 1912 for the purpose of compensating for the rise in the cost of raw materials, although the basis for the increases still existed in the prices of the materials.

**A Mistake in a Contract.**

The case of Commissioners of Works *v.* King, which was heard by Mr. Justice Sargant, on January 30th, affords an illustration of the ease with which a very serious mistake may creep into a contract. The contractors (Messrs. W. King & Co.) had undertaken the erection of a Post Office. They scheduled reinforced concrete at so much per "cubic yard," but when the schedules were sent to be typewritten the words were altered into "cubic foot." This mistake was not rectified in the two copies attached to the contract. Owing to this mistake the extras figured out at £23,000, although the tender had been but £20,000. In the circumstances the Commissioners applied for rectification; and the Court ordered the contract to be rectified, Mr. Justice Sargant saying that the conduct of the contractors was extravagant, as the slip was so obvious. Having regard to certain cases which appear in the law reports, it would seem that the Commissioners were somewhat lucky in escaping the consequences of the mistake; for it is to be borne in mind that they had an opportunity of correcting it at the time.

In the case of Seaton Brick Co. *v.* Mitchell (1900) 11 F. (5th ser.) 550, the defender offered to execute work for the pursuers for the lump sum of £859. His offer was accepted. He afterwards found that, owing to an error in calculation made by his son, the offer was £826 less than it should have been. In an action for damages for breach of contract, the defender having contended that this mistake released him from his contract, the Court held that he was not released—the mistake having arisen through no fault of the pursuers—and that the pursuers were entitled to damages. The episode brought to light before Mr. Justice Sargant recalls the case of the auditors who could not make out for a long time how the balance-sheet of a company was out to the extent of nearly £2,000. After prolonged investigation, it was found that by a typist's error the year of Our Lord had been added to the column of figures on the debit side!

## VACUUM.

By "WHISTLEFIELD."

Most steam users are aware, in a vague kind of way, that a good vacuum means a better engine efficiency, out very few take the trouble to find out the real reason why this is so; the generally accepted idea is that the vacuum adds a few pounds to the effective pressure of the steam, that is, a vacuum of 26 in. corresponds to a pressure, roughly, of 13 lb. below atmosphere, therefore a boiler pressure of 200 lb. will yield an effective pressure in the engine worked at this vacuum of 213 lb. While this is correct, it does not go far enough, for the gain from half an inch of extra vacuum usually means far more than an increase of 1 lb. in the effective steam pressure. Users of steam turbines, for example, have it impressed on them by the makers that the half inch of vacuum between 28 and 28½ in. is most desirable, leading to a large increase in the efficiency, the expensive and often elaborate appliances provided for ensuring a high degree of vacuum in turbine condensers being a proof of their claim.

The principles involved can be readily understood by a consideration of what happens when steam expands.

Fig. 1 shows an entropy diagram, which represents by its area the quantity of heat stored up in a pound of steam which has been expanded from a pressure of 200 lb. absolute (381° F.). to a pressure of ½ lb. absolute, or a vacuum of 29 in. (80° F.); from this diagram we can derive a great deal of useful information regarding the value of a good vacuum.

Horizontal lines have been drawn at temperatures corresponding to various pressures to enable us to find out the amount of heat, and therefore of work which is obtainable from any degree of steam expansion.

On measuring the shaded areas A, B and C, we find that the amount of energy liberated by each of these expansions

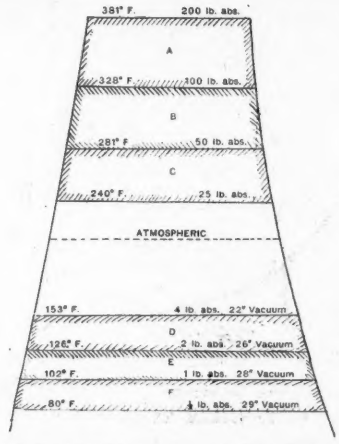



Fig. 1.—Entropy Diagram showing amount of work done during expansion of steam.

is approximately equal, for the heat areas are equal, that is to say, we get just as much work done when a pound of steam is expanded from a pressure of 200 lb. absolute to a pressure of 100 lb. absolute, as we get when the same weight of steam is expanded from a pressure of 100 lb. absolute, to a pressure of 50 lb. absolute, or from a pressure of 50 lb. absolute to a pressure of 25 lb. absolute.

If we measure the shaded areas D, E and F at the lower end of the entropy diagram we find that these also are approximately equal, though there is a difference of vacuum of 4 in. enclosed in the area D, of 2 in. enclosed in the area E, and of only 1 in. enclosed in the area marked F; that is to say, an increase of 1 in. of vacuum from 28 in. to 29 in. is capable of yielding as much useful work as an increase of 4 in. of vacuum higher up in the pressure scale; not only so, but the area marked F is approximately equal to the area marked A, so that an increase of 1 in. of vacuum from 28 in. to 29 in. is capable of yielding as much useful work as a drop of 100 lb. of steam pressure between 200 and 100 lb. absolute.

TABLE I.—Showing the Quantity of Heat Liberated by the Expansion of Dry Steam at Various Pressures to Different Degrees of Vacuum.

| Initial absolute pressure. | The quantity of heat in British thermal units liberated by expansion of 1 lb. steam to— | | | |
|---|---|---|---|---|
| | 14·7 lb. absolute. | 26-in. vacuum. | 27-in. vacuum. | 28-in. vacuum. |
| 200 | 189 | 302 | 316 | 336 |
| 175 | 180 | 294 | 308 | 328 |
| 150 | 169 | 284 | 298 | 318 |
| 125 | 156 | 272 | 287 | 308 |
| 100 | 140 | 258 | 273 | 294 |
| 75 | 119 | 239 | 254 | 275 |
| 50 | 89 | 211 | 227 | 248 |

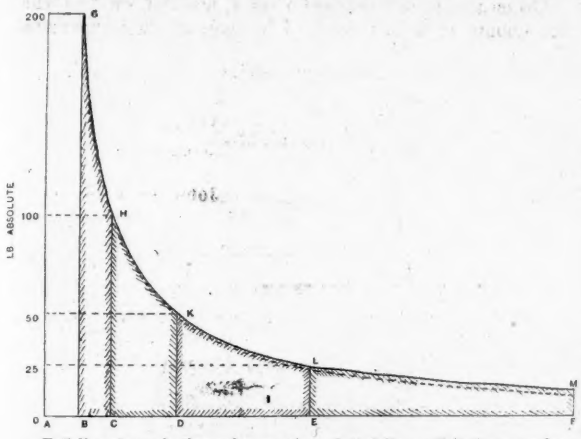
Table I shows the amount of energy measured in British thermal units which is liberated by a pound of steam when it is expanded from various pressures to different degrees of vacuum, one British thermal unit being equal to 778 ft.-lb. of work.

It is not generally realised that the energy liberated by the expansion of a given weight of dry steam depends on the number of times that the original volume is increased, and not upon the initial pressure at which the expansion takes place.

If a pound of steam, say, at a pressure of 200 lb. abs. is expanded isothermally, that is, with its temperature kept constant, the expansion will take the form of the full curve shown in fig. 2. If A B represents the original volume of

the steam at a pressure of 200 lb. abs., then when we expand it to twice the original volume, that is, to A C, the amount of energy liberated will be proportional to the area B G H C, and the pressure will have fallen from G at 200 lb. to H at 100 lb. abs.

If the quantity of steam A C at 100 lb. pressure be again expanded to double its volume, the pressure will again fall




Full line shows isothermal expansion; dotted line, adiabatic expansion.

FIG. 2.—STEAM EXPANSION DIAGRAM.

to one-half of the initial pressure according to the law governing the isothermal expansion of a gas, and the energy liberated will be proportional to the area C H K D. On measuring, it will be found that this area is equal to the area B G H C. If we still further expand the quantity of steam A D at 50 lb. to A E at 25 lb., and A E at 25 lb. to A F at 12½ lb., we will obtain the four shaded areas shown, each equal to the other. We thus see that the energy liberated when we halve the pressure of a given weight of steam is theoretically always equal, no matter whether the originally pressure was 200 lb. absolute or 1 lb. absolute (28 in. of vacuum).

Actually the expansion of steam in an engine or turbine is not isothermal but adiabatic, *i.e.*, with a fall in temperature, so that the isothermal curve is not obtained, and the adiabatic curve, shown by a dotted line, represents more accurately, the condition of affairs.

Since the adiabatic curve falls below the isothermal curve, each shaded area will be slightly smaller than the previous

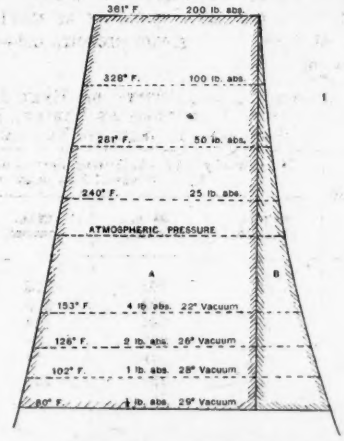



FIG. 3.—ENTROPY DIAGRAM SHOWING DIFFERENCE IN WORK DONE BY STEAM EXPANDED ADIABATICALLY (A) AND ISOTHERMALLY (A + B).

one. An entropy diagram can be made to show the amount of energy liberated by both the isothermal and adiabatic expansion of steam, and will thus indicate the difference between them. If we take saturated steam at a pressure of 200 lb. absolute and expand it adiabatically, the temperature falls and the steam becomes wet, that is, a portion of it condenses and can no longer expand to do useful work. If, on the other hand, we expand it isothermally we must supply extra heat to maintain its temperature constant; this keeps the steam dry, no energy is lost through condensation, and the total energy available is shown by the full area in fig. 3.

The portion marked A shows the amount of energy liberated by adiabatic expansion, and the area marked B shows the amount of energy lost through steam condensation. The diagram shows, therefore, that the difference between the amount of energy liberated by the isothermal and adiabatic expansion of steam increases the lower we go in the temperature scale, thus although theoretically the energy liberated in expanding steam from 28 to 29 in. of vacuum is equal to that obtained by expanding steam from a pressure of 200 lb. abs. to a pressure of 100 lb. abs., a greater amount of lost energy has to be deducted from that liberated between 28 and 29 in. of vacuum than from that liberated between a pressure of 200 lb. and 100 lb. abs.

Table II shows the volume of one pound of steam at different pressures ranging from 200 lb. abs. down to ½ lb. abs. or 29 in. of vacuum, and thus gives the actual ratio of

TABLE II.—THE VOLUME AND TEMPERATURE OF STEAM AT VARIOUS PRESSURES AND VACUUMS.

| Vacuum. | Abs. pressure in lb. per sq. in. | Temperature in degrees F. | Volume of 1 lb. in cb. ft. |
|---|---|---|---|
| 29 | ·5 | 80 | 640 |
| 28 | 1·0 | 102 | 335 |
| 26 | 2·0 | 127 | 172 |
| 22 | 4·0 | 153 | 89·6 |
| 14 | 8·0 | 183 | 47 |
| 0 | 14·7 | 212 | 26 |
| — | 25 | 240 | 16·1 |
| — | 50 | 281 | 8·4 |
| — | 100 | 327 | 4·4 |
| — | 150 | 358 | 3·0 |
| — | 200 | 381 | 2·3 |
| — | 225 | 391 | 2·0 |

the adiabatic expansion of steam. It is well known that as a rule, it does not pay to work reciprocating engines at a higher vacuum than 26 in. The above table shows one of the reasons. At the pressure corresponding to 26 in. of vacuum, 1 lb. of steam occupies 172 cb. ft., but at 28 in. of vacuum it occupies 335 cb. ft., and at 29 in. the volume has increased to 640 cb. ft. It is evident that a low pressure cylinder large enough to accommodate such a great volume of steam would present mechanical difficulties which would make the cost of construction prohibitive, and thus neutralise all the economy to be obtained by the increased vacuum; also from this table, as well as from fig. 1, we see that the temperature of the steam falls very rapidly with increasing vacuum, for whereas there is a drop of only 26° for the 4 in. of vacuum between 22 in. and 26 in., there is a drop of no less than 47° for the 3 in. of vacuum between 26 in. and 29 in.

In a reciprocating engine, where the whole expansion takes place in a few stages only, the final temperature in the low-pressure cylinder would be so low if the vacuum were high, that enormous initial condensation would take place when the steam from the intermediate cylinder was admitted.

With turbines neither of these objections exist. The steam flows through the turbine in a steady stream, so that smaller volumes have to be dealt with than in a reciprocating engine of the same power, and the diameter of the turbine rotor and the length of the blades at the low-pressure end can be increased for almost any degree of expansion without entailing any difficulties in design or construction.

The expansion of the steam takes place in so many stages that the drop in temperature in each stage is comparatively small, the condensation is consequently reduced, so that we can approach more nearly the theoretical gain in efficiency.

To summarise the above points regarding vacuum, we see :—

1. That the energy liberated by the expansion of steam is proportional to the number of times the volume has been increased, less a small loss due to natural condensation owing to the fall in steam temperature, and this condensation can be considerably reduced by superheating.

2. Taking the present practical working steam pressures as ranging from 225 lb. absolute to ½ lb. absolute (29 in. of vacuum), we find that from a pressure of 225 lb. absolute to

atmospheric pressure we have almost a fourfold expansion, but from atmospheric pressure to a vacuum of 29 in. we have a fivefold expansion, so that, theoretically, there is over 30 per cent. more energy to be obtained from the practical vacuum range than from the practical pressure range.

3. Reciprocating engines have been unable from their very design and method of working to employ usefully this

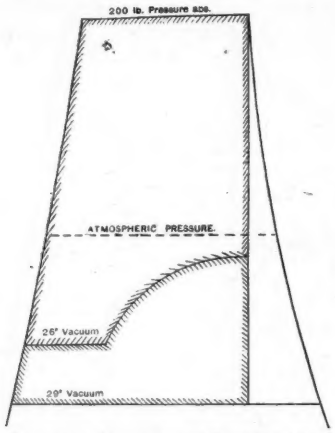



Fig. 4.—Showing Amount of Energy Utilised by Reciprocating Engine Expanding to 26-in. Vacuum and Amount Utilised by Turbine Expanding to 29-in. Vacuum.

wide range of vacuum, for even when working at a vacuum of 26 in., we see from fig. 4 that the compression reduces the amount of the available energy.

4. Turbines, on the other hand, are adapted by their design and method of working to employ usefully all the vacuum which it is possible to produce, so that it is becoming increasingly common to combine exhaust steam or else mixed pressure turbines with existing installations of reciprocating engines to make full use of the energy liberated by high vacuum.

## CORRESPONDENCE.

*Letters received by us after* 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

### Insulated Aluminium Cables.

If not too late, the writer would be glad to tender a few remarks regarding the article under the above heading appearing in your issue of January 9th.

As one who has perused this article with interest, I think it somewhat of a pity that more complete information was not given. For instance, no unit prices for paper or lead are published, and as every cable designer will know, the cost of the latter metal will make all the difference between a saving in favour of aluminium and a loss.

The extent to which aluminium cables have been used in this country is, of course, limited, due to the hitherto high price of the metal; it is therefore interesting to note that the English price for aluminium wire is in the neighbourhood of 20c.

As regards the manufacturing cost, it seems somewhat strange that these should lie along straight lines, because one seldom expects that the large cables will cost as much per lb. as the small ones. Moreover, practice does not give reason to the conclusion that if an aluminium cable of 1·4 sq. in. section is 10 per cent. cheaper than the equivalent copper, an aluminium cable of half the section will show the same per cent. economy.

The article is of considerable interest as far as it goes, but I think the author would add to its value by giving a little more specific information in regard to manufacturing costs and unit prices, together with some particulars as to the manner in which the users of aluminium cables are solving the jointing problem.

**Ernest V. Pannell.**

New York, *January 30th*, 1914.

In answer to Mr. Pannell's letter, the curves given in the article in question are based on average prices for the cost of labour and all materials other than copper or aluminium, and will give the saving per mile by using aluminium with sufficient accuracy to determine whether or not the use of aluminium is justified. Any correction for other variables would make the comparison too troublesome for practical application. I agree that the price per pound of heavy cables will be less than that for smaller cables; but the curves given represent the cost per unit of length, not per unit of weight, and are actually very nearly straight lines. With regard to jointing, Mr. Pannell should apply to the British Aluminium Co., of 92, Queen Victoria Street, who have developed a most efficient type of clamp for all kinds of joints.

**John B. Sparks.**

London, N.W., *February 17th*, 1914.

### The Design of Regulating Resistances.

With reference to Mr. L. Boothman's very interesting article on "Notes on Design of Regulating Resistances" in your current issue, it is stated therein that an empirical formula which has been found to give accurate results in practice for the "summation watt" capacity of a regulator is—

"Total rheostat ohms × maximum amperes × minimum amperes."

I have checked up the area of the lower curve in fig. 1 by Simpson's rule, as suggested, and it certainly agrees with the formula suggested by Mr. Boothman.

The formula must, however, be used with caution, as the following will illustrate. It may be written—

$$R \times I_{max.} \times V/(R + R_f),$$

where $R$ = rheostat ohms and $R_f$ = field coil ohms.

With $R$ very large this becomes approximately equal to

$$I_{max.} \times V = \text{constant}.$$

That is to say, the formula indicates that increasing the resistance beyond a certain value does not appreciably increase the total watt capacity, which is obviously wrong.

After all, the "summation watt" capacity of a regulator is only required for purposes of comparison and for cost estimating purposes. I am inclined to think that the formula "square the mean of the maximum and minimum amperes and multiply by the resistance of the rheostat" is the better all-round one. It can be applied to potentiometer rheostats, to which Mr. Boothman's formula certainly cannot.

**Charles C. Garrard.**

Sutton Coldfield,
*February 14th*, 1914.

### The 1/13-Watt Lamp.

It is interesting to see the electric arc lamp inviting the electric glow lamp to be honest. For years the 5-watt carbon lamp has called itself 3·5 or 4 watts, and for fewer years the 2·2-watt metal-filament lamp has called itself 1·5 watts. Latterly, the 1·5-watt metal-filament lamp has called itself 1·25 watts, and for a brief period it actually became "one-watt."

It is just possible that a real one-watt lamp has now arrived—it is to be hoped it is not the half-watt in disguise. Possibly someone as well acquainted with arc-lamp tests as the writer is with glow-lamp tests can offer the parallel.

**Disinterested.**

### "Cables and Strategy."

Domestic trouble and ill-health prevent my dealing fully with the eminently "superior," though anonymous, person responsible for your leading article under the above title.

As, however, the writer uses the expression "he (meaning myself) asks us to believe," I hope you will allow me to invite your readers to read my *Quarterly Review* article for themselves, when they will, I think, be better able to judge of its actual scope and the views expressed therein.

I would further add that I am not particularly likely to be forgetful of "the arguments of those in favour of private

ownership," especially in connection with the land telegraphs of the United Kingdom, if only in view of my father's and uncle's somewhat close association with the old "Electric," and still more the "Magnetic," Telegraph Co. Moreover, it was but the other day that I was reminded that the Government of the time had (as usual) refused to lend any aid to the promoters of the early telegraph companies when risking their time and money in the enterprise. But highly successful as these companies were when absorbed by the State, I am also mindful of the fact that, though the State "runs" our telegraph system at a loss, wires are now taken to many an outlying district such as the companies refused to afford telegraphic facilities for, except under quite favourable terms.

Again, in proof of the fact that I have not been neglectful of the advantages of private ownership as applied to ocean telegraphy, I would remind you that my article clearly suggests (page 142) that State ownership should be closely limited to certain inter-Imperial communicating links.

Your anonymous writer's method of expressing disagreement, is to speak of me as "falling into the error of supposing," &c. His remarks on the point he is referring to, I have not yet been fully able to follow; but, so far as I can see, he does not seriously contest my suggestion that the national control of a cable immediately preceding warfare, is often by way of being more important than when hostilities have actually broken out.

I will only remind you, in conclusion, that the subject dealt with in my article (covering some 13 pages) is one I have somewhat closely studied from all points of view, and without any interest at stake, for a good many years, rather more even than your anonymous writer, despite his somewhat "superior" and didactic tone.

**Charles Bright.**

Hastings, *February 10th*, 1914.

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### The P.M.G. and Users of Wireless Receivers.

Mr. F. Hope-Jones is to be congratulated on the successful result of his protest against the Gilbertian proposal of the Postmaster-General to levy a tax on users of wireless apparatus for receiving the international time signals, and I am sure he has earned the hearty thanks of all users of such apparatus.

If this success has whetted Mr. Hope-Jones's appetite for more, I would suggest that his next campaign should be against the regulation which requires that users of wireless receiving sets should be licensed. It is quite reasonable that transmitting sets should be inspected and licensed, as the uncontrolled use of such apparatus would lead to chaos in wireless communication, but why should it be necessary to inspect receiving sets which cannot in any possible way interfere with the working of other wireless apparatus? The Postmaster-General might as reasonably insist on the inspection and licensing of those who "have ears to hear."

In this connection it is interesting to note that the regulations recently issued in the United States respecting amateur licences do not require that users of receiving sets should be licensed. The words "receiving . . . . radiograms . . . . and of transmitting, &c.," which appeared in the old form of licence have been replaced by the words "transmitting private radiograms or signals, &c." It will be noted that the words "for receiving" have been omitted from the new licence forms.

**Contractor.**

Glasgow, *February 16th*, 1914.

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### The Great Eastern Railway.

I do not know if Lord Claud Hamilton has done well or ill in bringing in a general manager from America, but past experience of Americans in business here has not been happy owing, we fear, to the American habit of spread-eagleism, and their frequently crude manners and methods.

Lord Hamilton has avowed his own incapacity to find a man in Britain fit to manage a railway; the share list seems to us, by the gradual downward progress of Great Eastern stock under Lord Claud's rule, to show a certain incapacity for his Lordship in his post of chief of this unfortunate railway. And is this iron-jawed American, who we quite think can manage a railway, to be managed by Lord Claud and his colleagues at Liverpool Street? If there are no good men available in Britain, we have a third charge of incapacity to level against the whole tribe of titled railway magnates in our snob-ridden land. By what moral right does Lord this or the Lord that sit on a railway board? What experience has Lord Claud himself as a fireman or driver, a booking clerk, a traffic official or a—anything practical in railway work? Our British brains may not elect to kow-tow to the titled men who usurp the places of better ones, and I sadly fear that really good men are not to be found in plenty on our lines. But is it not to such as Lord Claud that this paucity is due; to their policy of repression of good men that good men have left railways neglected? Mr. Thornton may succeed if he can keep his ability in face of a railway board, and can leave behind him that self-importance which has ruined so many Americans here. Any effort he can make to break the crusted methods of title-ridden railwaydom will be welcome to all of us. The Great Eastern Railway ought to be made to pay. Let Mr. Thornton do this by reducing charges for goods to a reasonable figure and he will be blessed all round. Can he find any good in Mr. Gattie's clearing-house scheme for London, and if he can, will he be able to link up with other lines in an effort to put all lines on a basis of sound working? But really, in condemning all our railway men, Lord Claud has condemned more his own co-directors. It is time that titles and social position stepped aside! A title does not fit a man for anything, yet men of title seem to think it does, for they seize positions and salaries to which they have no real claim of any sort. Influence has done much harm.

**'Nuff Said.**

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### A Query.

Can any reader suggest a method of coupling transformers to obtain single-phase current from three-phase supply, the load on the three phases to be balanced?

**Ignoramus.**

Leeds, *February 13th*, 1914.

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### Alterations to Dynamo.

Replying to your correspondent's proposal to increase the voltage of a 255-volt dynamo to render it suitable for charging accumulators, the alterations to the field windings he mentions may or may not give the requisite increase. This, of course, depends on the degree of saturation of the field magnets, and can easily be tried with the existing field coils. Presuming the dynamo has four poles, and that the shunt coils are connected in series with each other, these may be reconnected so that two of these coils in series are joined in parallel with the other two coils that are in series. Care should, of course, be taken in reconnecting that the polarity of the magnets is not altered. This rearrangement will about double the current passing through each field coil, or about quadruple the total shunt current.

The dynamo can then be run for a few minutes on light load to see what increase of voltage results. It can then be decided what alterations should be made to secure the necessary higher pressure.

**R. Ainsworth.**

Salford Rolling Mills, Manchester.
*February 16th*, 1914.

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**London Electric Supply Bill.**—According to the *Financier*, certain of the West End companies—including the Westminster Co. and the St. James' and Pall Mall—are petitioning against the London Electric Supply Bill, 1914, which has been introduced on behalf of the London electric supply companies as a whole, having for its object the extension of the period of purchase. The petition is, however, not of a hostile nature, but merely to obtain a *locus standi* in order that, as the Bill proceeds, they may have the opportunity of introducing any clause which they may think necessary to cover any point affecting their company's individual interest.

D

## THE TRADE OF ARGENTINA.

In a recent report on the trade of Argentina, the British Consul at Buenos Aires states that the demand for electricity, both for motive power and lighting purposes, increases every year. In the city of Buenos Aires electricity has hitherto been a German monopoly. The Italian financiers mentioned in a previous report have obtained a concession from the Government and have formed a company. Backed as this company appears to be by a powerful syndicate of European financiers, which has a capital at its disposal of £3,000,000, the German monopoly is threatened. The electrical installations of the new company are being pushed forward with all speed, and a central power station is in course of construction in the centre of the town. The cables, machinery, etc., came from Italy and Spain. The task of vanquishing German competition will not be an easy one. The Germans were the first in the field, and are naturally fairly established in the city. The German plant is one of the largest of its kind in the world, and is valued at £1,000,000. The company are at present actively extending their system to the suburbs, at an estimated cost of £400,000, and competition is likely to become keen. British capital is represented by an electricity company which holds concessions for the towns of La Plata, Ensenada, and Tucuman. The annual balance-sheets of the company show a steady and continuous growth of business in La Plata and Ensenada, but at Tucuman the company has to encounter the competition of a company which has recently started operations. In order to meet this competition the British company has amalgamated with another company. Should the extensive schemes for the electrification of the suburban railways materialise, a considerable demand for plant is likely to follow. An important contract was obtained by a London firm for the Central Argentine Railway some little time ago, in open competition with foreign firms, and the work undertaken will consist of supplying and laying underground cables, to be completed in 18 months. The output of the German company in 1912 was as follows:—

| | | |
|---|---|---|
| Light ... ... ... ... | 57,153,400 | kilowatts. |
| Power ... ... ... ... | 22,830,300 | ,, |
| Traction ... ... ... | 60,948,200 | ,, |
| Total ... ... ... | 140,931,900 | ,, |

The returns of the same company for 1911 showed a total of 128,829,100 kilowatts.

The British Consul at Bahia Blanca reports that great advantage has been derived from the economy and efficiency resulting from the extensive use of electricity in Bahia Blanca, and the Pacific Railway has been foremost in this enterprise. The company's newly constructed power house has a capacity of 5,000 kilowatts, but is designed for increased power when necessary. It also provides power for the Bahia Blanca tramways and the South American Light and Power Company, the holders of a concession for the street and private lighting of Bahia Blanca. The approximate annual output is as follows:—

| | | |
|---|---|---|
| South American Light & Power Co. | 2,100,000 | units. |
| Pacific Railway ... ... ... | 1,175,000 | ,, |
| Tramways ... ... ... ... | 900,000 | ,, |
| Total ... ... ... ... | 4,175,000 | ,, |
| Total units generated and used in power house ... ... ... | 5,950,000 | |

The Bahia Blanca tramways were opened to the public service in 1910, being then the property of the Buenos Aires and Pacific Railway Company. They are now the joint property of that railway and of the Great Southern Railway Company. The rolling stock consists of single-deck electric cars mounted on maximum traction bogies and equipped with 25-h.p. Westinghouse motors. The power is derived from overhead lines.

The British Vice-Consul at La Plata states that the tramway service of that town and suburbs is supplied by two companies, whose lines intersect the different streets and converge in the depôt of the Great Southern Railway. The branch lines furnish easy communication between La Plata and Tolesa, Los Hernos, Berisso and Ensenada. The frequent tramcar services of La Plata are maintained by two companies. The company called La Nacional was the outcome of an amalgamation of two old horse systems, of which one was originally under the direction of the municipality. The company is a purely local concern, with a capital placed at some £180,000. The second company is a British company known as the La Plata Electric Tramways Company. It has a capital of £550,000. The net revenue for 1912 gave a balance of £9,782, but the electrification of the system was not then complete. At the time of writing the whole of the company's lines, with the exception of small extensions, were electrified—a circumstance that should conduce to an increased revenue.

Dealing with the general trade position, the Consul at Buenos Aires calls attention again to the advantageous position of the United Kingdom due to the widely different economic conditions of the two countries, which places each in a position to supply what the other requires. British prosperity in Argentina remains unaltered. The prophecies that the United Kingdom will be overtaken by her foreign competitors in her commercial operations in Argentina do not find any support in the official trade statistics. While the imports from the United Kingdom show an increase of £2,006,300 in 1912 over 1911, those from Germany, our active rival in this country, have actually declined by £384,100. On the other hand, the United States is undoubtedly devoting greater attention to this market than in past years, and its efforts to increase its volume of trade have been bold and determined. Some prominent United States citizens have visited the country, the last of them to come being a deputation from the Boston Chamber of Commerce, and endeavours are being made to establish direct steamship communication. The advent of the United States capitalist unfortunately no longer symbolises a mere increase in trade competition that more often than not acts as a stimulant to rivals in the market of a young and prosperous country like Argentina. The method of the trust is too often a policy that crushes competitors by making them trade at a loss only to reap benefits out of the people as soon as the vanquished rival disappears from the scene. It may be said that our trading interests extend a long way beyond the mere figures of external commerce, as represented by the imports and exports. Argentina's magnificent system of railways alone accounts for £194,500,000 of British capital, to say nothing of the extensive dock works, tramways, water and irrigation works, meat-freezing, sugar, and other industries and the sea carrying trade. Enterprise in Argentina is as yet far from having attained its zenith, and British capital continues to flow into the country. The following table shows the total volume of the imports into Argentina from the United Kingdom, Germany, and the United States:—

| From | 1911. £ | 1912. £ | Increase or Decrease. £ |
|---|---|---|---|
| United Kingdom | 21,727,500 | 23,733,800 | +2,006,300 |
| Germany ... ... | 13,172,400 | 12,788,300 | − 384,100 |
| United States ... | 10,470,700 | 11,825,900 | +1,355,200 |

In 1912 the growing need for a British Chamber of Commerce was forcibly brought home to the British residents in Argentina by H.M. Minister at Buenos Aires, under whose auspices a renewed and successful attempt has been made to materialise the abandoned scheme. The opposing elements have at last yielded to the dogged perseverance of its organisers, and the United Kingdom will shortly derive in the fullest measure the advantages and assistance which an influential and active body of British merchants is likely to bestow upon the trade of their country. The Chamber is being rapidly organised, and there can be no reasonable doubt that the aims and objects that have called it into existence will be scrupulously carried out by its representative committee under the able leadership of its president, Mr. Hope Gibson, an old and highly esteemed resident in Buenos Aires. The objects of the Chamber are:—

(1) To assist members in any negotiations or difficulties with the Argentine authorities.
(2) To assist them in trade or labour disputes.
(3) To put them into touch with commercial firms.
(4) To look out for Government and other contracts and for trade openings generally.
(5) To make translations of laws and tariffs.
(6) To collect and tabulate statistics.
(7) To study Customs tariffs and take action on behalf of members in Customs disputes.
(8) To promote and organise British trade.
(9) To help members to assert their trade rights and protect them against unfair competition, falsification of trade marks, and so on.
(10) To take action with a view to improving postal and other communication with the United Kingdom.
(11) To assist members in finding employees.
(12) To provide a centre where local members can meet and discuss matters of mutual interest.

The address of the Chamber, where further enquiries should be made, is British Chamber of Commerce for the Argentine Republic, 643, Calle Sarmiento, Buenos Aires.

**How to Save Wages.**—A certain private power plant, including boilers, turbines and motor-driven machinery, some years ago was run with a staff per shift consisting of the following members:—Shift engineer, turbine driver, stoker and trimmer. There were in addition a leading stoker and a cleaner, both working on day shift.

The staff has been gradually reduced until it now consists of shift engineer, stoker and trimmer per shift, without any spare men, and from 6 p.m. on Saturday to 6 a.m. on Monday the trimmer is off duty, the trimmers working 12-hour shifts with week-ends off.

The next step taken by the employers has been to reduce wages by about 25 per cent. in the case of the shift engineers and cleaners, but not the stokers, who are now in receipt of the highest wages paid on the job. The shift engineers' duties are to supervise the running of the station, attend to the running of the turbines (and the condensing plant at week-ends), carry out any repairs and overhauling and other duties that the chief thinks fit to give them, for the salary of 30s. a week. No holidays are given, unless 12 hours' work is done to counterbalance the time off. The station pressure is 3,300 volts, and the plant has a total capacity of 2,500 kw. The facts speak for themselves, and we commend the case to the notice of the A.E.S.E.

# NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

## Osram Packing Boxes.

The General Electric Co., Ltd., of 67, Queen Victoria Street, E.C., have now introduced special packing boxes for Osram drawn-wire tungsten lamps containing lots of 100, which they recommend to purchasers on account of the saving in carriage and smaller space required for storage.

The boxes are of superior appearance and finish, and are attractive from an advertising point of view.

## G.E.C. Half-watt Lamps in Service.

We illustrate herewith one of Messrs. Harrod's showrooms, which has been equipped with 100-volt 1,000-c.p. half-watt Osram lamps, wired two in series.

These are each contained in a G.E.C. sphere fitting, and have replaced a similar number of arc lamps run in pairs. We understand that, as compared with the displaced arc lamps, the colour of the light is greatly improved, being much whiter, and better for coloured fabrics. The photograph was taken by the light of the lamps themselves.

Fig. 1.—Half-Watt Lamps in Use.

## A New Electrodynamic Frequency Meter.

Messrs. Hartmann & Braun have recently introduced a new frequency meter of the ordinary dial form in addition to their well-known vibrating reed type. The connections of this new instrument are shown in fig. 2. It consists of a set of four alternating magnet poles, which combine to set up two resultant fields $F_1$ and $F_2$ at an acute space angle $\psi$ to one another, as shown in fig. 3. These fields act on a freely suspended coil, S, which, in order to ensure as regular a scale as possible, is given the shape shown in fig. 2. This coil is connected in series, with one pair of the field coils ($f_1$ $f_2$) by means of two fine bronze strips of negligible torsion. This circuit is connected in series with a condenser C across the mains whose frequency is to be measured. A second parallel circuit consists of the remaining two field coils $f_3$ $f_4$ and the choking coil D. The currents $i_1$ and $i_2$ in these circuits lead and lag respectively with regard to the supply volts.

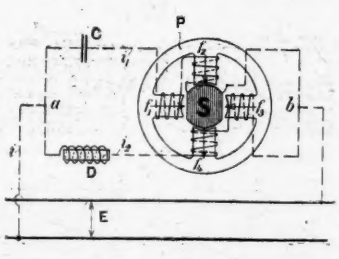


Fig. 2.—Connections of New Frequency Meter.

Since there is practically no control force on the suspended coil it will take up a definite position such that the opposed torques $D_1$ and $D_2$ due to the two resultant fields $F_1$ and $F_2$ are equal. For the sake of simplicity, the resultant fields $F_1$ and $F_2$ may be assumed to be in phase with the currents $i_1$ and $i_2$ respectively. The field F of the moving coil also is in phase with the current $i_1$. If $y$ (fig. 4) is any given angle of space displacement between the fixed field $F_2$ and the moving-coil field F, then—

$$D_1 = c\,F\,F_1 \cos 0^\circ \sin(y - \psi)$$
$$\text{and } D_2 = c\,F\,F_2 \cos\phi \sin(360^\circ - y),$$

where $c$ is a constant and $\phi$ is the angle of phase difference between the currents $i_1$ and $i_2$ (or between the fields F or $F_1$ and $F_2$) (fig. 5).

Equating these two torques and assuming that the fields $F_1$ $F_2$ are proportional to the currents $i_1$ $i_2$, and that the turns producing $F_1$ and $F_2$ are equal :—

$$i_1 \sin(y - \psi) = -\, i_2 \cos\phi \sin y,$$

or $i_1 \sin y \cos\psi - i_1 \cos y \sin\psi = -\, i_2 \cos\phi . \sin y.$

Dividing both sides by $i_1 \sin y \sin\psi$ :—

$$\text{cotan}\,\psi - \text{cotan}\,y = -\, i_2/i_1 \,.\, \cos\phi/\sin\psi.$$

Now the saturation of the iron is so chosen, that within the working range of the instrument the space angle $\psi$ is practically constant, so that this last equation may be written in the form :—

$$\text{cotan}\,y = a + b\, i_2/i_1 \,.\, \cos\phi,$$

where $a$ = cotan $\psi$ and $b = 1/\sin\psi$, and both are constant.

Since both the ratio $i_2/i_1$ and the value of cos $\phi$ fall with increasing frequency, any change of frequency produces a marked effect on the instrument deflection $y$. The actual variations in the various quantities are shown by the following measurements made on a finished instrument for 45 to 55 cycles, with an angle $\psi$ of 32° :—

| Alternations per sec. | 2 × 45 | 2 × 47 | 2 × 50 | 2 × 53 | 2 × 55 |
|---|---|---|---|---|---|
| $i_1$ ... ... ... | ·0342 | ·0396 | ·0456 | ·0505 | ·0515 |
| $i_2$ ... ... ... | ·074 | ·0705 | ·067 | ·058 | ·051 |
| $i = \sqrt{i_1^2 + i_2^2}$ ... | ·056 | ·054 | ·054 | ·056 | ·057 |
| $\phi$ ... ... ... | 133·5° | 130·5° | 126·5° | 118·5° | 113·5° |
| cos $\phi$ ... ... | —·688 | —·649 | —·595 | —·477 | —·399 |

Here, $i_1$ $i_2$ and $i$ were measured by milliamperemeter, and the value of $\varphi$ was then estimated graphically by drawing the current triangle. It will be seen that the ratio $i_2/i_1$ changes approximately as 2 : 1 within the range of the instrument, whilst cos $\phi$ changes almost to the same degree. The open and regular nature of the scale attained is a valuable feature. The total current consumption of the instrument is about 60 milliamperes. Ordinary temperature variations have no effect on the readings, and voltage variations of ± 30 per cent. also have no effect. At the same time, the instrument is practically unaffected by variations of wave form, even when the variations from the sine wave are very considerable.

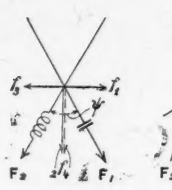


Fig. 3.

Fig. 4.

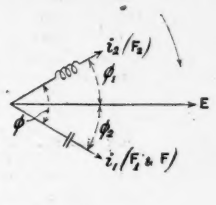


Fig. 5.

The instrument is made up in round form with maximum diameters of 9 in., 12 in. or 14½ in., and the scale is marked either in alternations or complete periods.—*E.T.Z.*

## Pressure-Controlled Speed Regulator.

In fig. 6 we illustrate an "Igranic" patent pressure-controlled speed regulator, made by the Igranic Electric Co., Ltd., of 147, Queen Victoria Street, E.C., for use in connection with electric motors operating fans or blowers used in mechanical draught systems, the object being automatically to maintain a constant boiler pressure by varying the speed of the motor inversely in accordance with variations in the boiler pressure.

So long as the steam pressure is constant the speed of the motor is not changed, but any variation in pressure above or below the amount for which the controller is adjusted results in a decrease or increase of motor speed, the draught being thus automatically regulated so as to keep the boiler pressure practically constant.

The speed regulation may be obtained either by armature or shunt field control or by a combination of both.

The regulator consists of a slate panel mounted on the front of an angle-iron cage in which the necessary resistances are contained. The panel carries the contact segments over which a double-ended lever moves.

The lever is actuated by the piston of an hydraulic or compressed air cylinder, fitted with a pilot valve controlled by the movement of a diaphragm, one side of which is subjected to the boiler pressure.

The normal boiler pressure on the underside of the diaphragm is balanced by a weighted lever bearing upon the top of the

diaphragm in such manner that this lever will rise or fall as the boiler pressure rises above or falls below the normal pressure for which the lever is counterbalanced. This up and down movement of the lever operates a pilot valve controlling the admission of water or air to the cylinder shown to the left of the slate panel, and, due to this pressure, the piston of the cylinder is moved back and forth, operating in turn the double-ended lever which rides over the contact segments mounted on the slate.

The operation of cutting the resistance in and out is not a continuous one, but proceeds step by step with a pause after each movement of the contact lever.

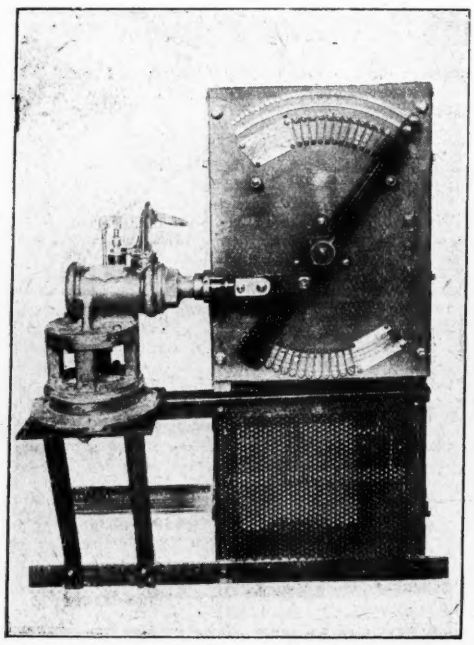

Fig. 6.—Pressure-Controlled Speed Regulator.

There are many other purposes to which this pressure-controlled speed regulator is applicable in a similar manner, as, for instance, boiler feed pumps, gas pressure blowers, &c., and the same system of control can be adapted for either direct-current or alternating-current motors.

## Oil Drying and Testing Apparatus.

We have received from Mr. George Lister, of Dursley, particulars of the Hunt transformer oil-drying and oil-testing apparatus, for which he is sole European agent.

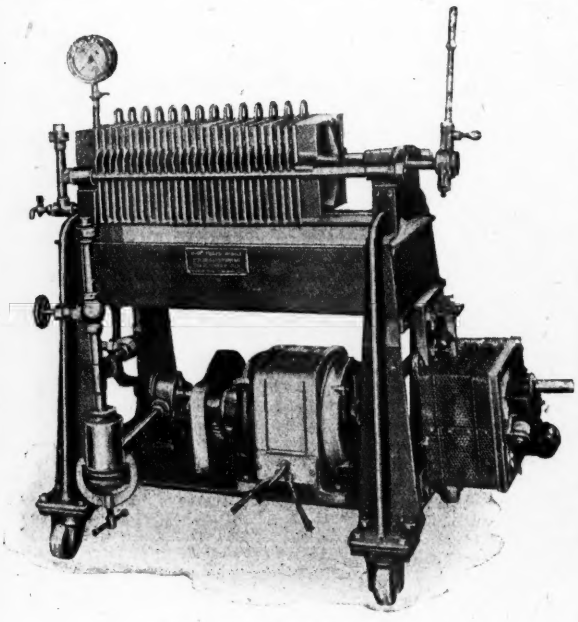

Fig. 7.—Oil Filter Press.

The necessity for using dry and clean oil in transformers is well appreciated, as the greatest number of failures of oil-cooled transformers is caused by deterioration of the oil from one cause or another. The apparatus here referred to consists of an electric drying oven, made in sheet-steel, which holds about five complete charges of filter paper, which is subjected to a temperature of 80° C. for from 24 to 48 hours. The oven contains four incandescent heating lamps.

The dried paper is placed in a filter press, fig. 7. About 200 sheets of 12¾ in. square filter paper constitute the full charge for a press, being placed five sheets together on each side of each of the 20 frames. Each frame forms an oil well, and the oil is forced by means of a motor-driven geared pressure pump, through the filter paper in each direction against the corrugated surface of the frame.

The machine illustrated is fitted with a constant speed induction motor and raw hide gearing; it has a capacity of six gallons of filtered oil per minute. A larger machine for 20 gallons per minute is fitted with a centrifugal-type pump.

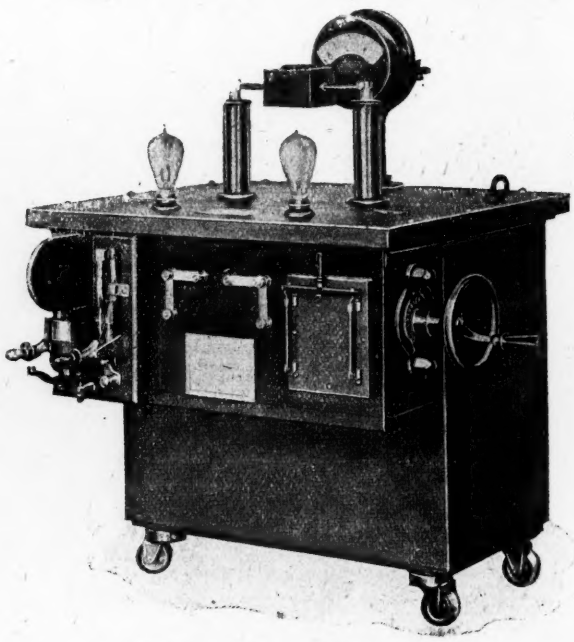

Fig. 8.—Oil-Testing Transformer.

Fig. 8 illustrates a 50,000-volt oil-testing transformer set, rated at 2 K.V.A., 60 cycles, 100-200/50,000 volts. It is fitted with a variable resistance, circuit breaker, oil-testing gap, pilot lamps, main switch and voltmeter for reading H.T. pressure direct.

The transformer is of the core type, oil insulated, and mounted on a sheet-metal case.

The variable resistance is of the compression type, adjusted by a hand wheel; the oil-testing gap is of small capacity, and about four tests can be made from the ordinary sample 4-oz. bottle of oil. The electrodes consist of two ½-in. diameter metal disks, which are adjustable, and usually set ·2 in. apart, and a steel gauge is provided for setting them.

The voltmeter is of the Weston dead-beat type, reading direct between zero and 50,000 volts.

## Standard American Charging Plugs for Electric Vehicles.

In a recent issue of the *Electrical World* were shown the standard forms of charging plugs and receptacles recently adopted by the Electric Vehicle Association of America.

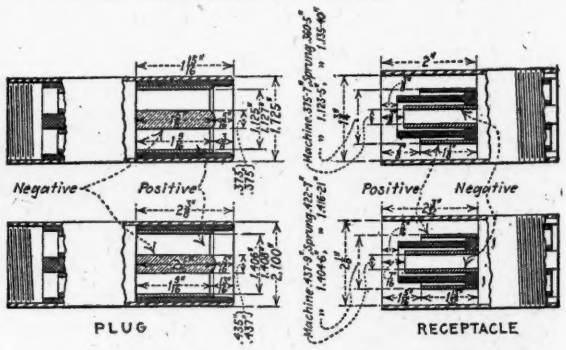


Fig. 9.—Standard Forms of 50-ampere and 150-ampere American charging Plugs and Receptacles for Electric Vehicles.

The outside contact, it will be noted, is of positive polarity while the inner contact is negative. Terminals should be marked

with plus and minus signs to correspond with the polarity above given. The dimensions shown relate to plugs and receptacles for carrying 50 amperes and 150 amperes respectively, and the National Board of Fire Underwriters has approved plugs of these dimensions for overloads of 50 per cent. beyond the current ratings given. In constructing the plugs it is desirable that the contacts be accurately concentric to ensure interchangeability.

### Explosion-Proof Gate-End Switch.

We have received from Messrs. Reyrolle & Co., Ltd., of Hebburn-on-Tyne, particulars of a gate-end switch which they manufacture in large quantities for underground work.

The switch consists of their three-phase, 500-volt, 50-ampere explosion-proof oil-break switch, combined with a dividing box. A gland for armoured cable is provided at one end, and at the other end there is fixed a watertight plug and socket, the plug

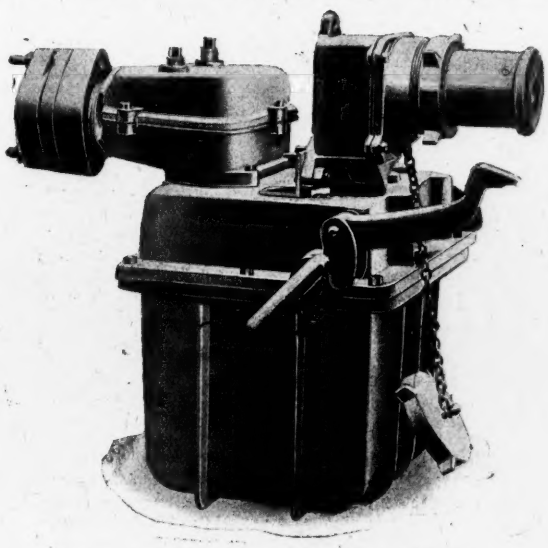

Fig. 10.—Explosion-Proof Gate-end Switch.

being interlocked with the handle of the switch, so that the plug cannot be withdrawn or inserted while the switch is in the "on" position.

If necessary the switch could be used as a gate switch, and could be fitted with either a watertight plug at each end, or a dividing box at each end instead of one box and one plug as shown, also the dividing boxes can be of either vertical or horizontal type.

The whole arrangement is very compact and, at the same time, is sufficiently strong mechanically to withstand rough usage.

Messrs. Reyrolle are issuing a pamphlet, No. 193, dealing with this switch, copies of which can be obtained on application.

### The "Pyrene" Fire Extinguisher.

On Thursday afternoon last week, through the courtesy of the Western Electric Co., Ltd., North Woolwich, we were present at a demonstration of the capabilities of their Pyrene Fire Extinguisher.

This device consists of a strongly built brass cylinder 14 in. × 3 in. dia., in which is incorporated a double-acting pump, by means of which the contained liquid—about one quart—can be projected in a continuous stream on to the fire. The apparatus weighs only some 5 lb., and will throw a jet 30 ft.

Of its effectiveness as a fire extinguisher, the dozen or so tests carried out during the afternoon, under the difficult conditions associated with a high wind and most inflammable materials, left not the slightest doubt.

Petrol, acetylene gas, celluloid, petrol saturated cotton waste, wood wool, wood, and bitumen were ignited in turn, and in some cases allowed to burn fiercely before being rapidly extinguished by the Pyrene apparatus.

Possibly the most striking test of the efficiency of these small extinguishers was a demonstration of the futility of trying to extinguish a burning stream of petrol with two well-known liquid extinguishers, each of about three gallons' capacity. Although these cylinders were exhausted in the unsuccessful attempt to put out the flames, yet with the small Pyrene apparatus there was no difficulty in smothering out the fire. The secret of its effectiveness is the contained liquid, which generates a large volume of heavy inert non-poisonous gas, especially where the temperature is above the normal, and this gas practically blankets the burning material, cutting off the supply of air necessary for combustion.

The liquid is harmless to fabrics, machinery, polished woodwork or foodstuff, and is, morever, a non-conductor of electricity.

Fig. 11.—Pyrene Extinguisher.

To the electrical engineer the Pyrene extinguisher is valuable, as its use, for instance, on a telephone switchboard in no way damages the latter, and, indeed, telephone equipment will operate almost as well when soaked in Pyrene liquid as when dry. The liquid can be pumped on to rotating electrical machinery without damage to the machine or danger to the operator; it will, moreover, extinguish an electric arc with considerable power behind it.

The harmless character of the liquid deserves emphasis, as that employed in some chemical extinguishers will do almost as much damage to objects in the vicinity of a fire as the fire itself.

The Pyrene apparatus costs about half as much as a chemical extinguisher, and costs less to refill; its small size enables it to be conveniently carried about (on a motor-car, for instance), and it appears to be ideal for domestic use.

## LEGAL.

### Day *v.* Willard and Others.

*(The Ruthenburg Electric Furnace.)*

On Friday, February 13th, Mr. Justice Pickford, in the King's Bench Division, delivered his reserved judgment in the action heard before him in January last, and reported fully in the Electrical Review, January 23rd, page 145.

Mr. Justice Pickford, in giving judgment, went into the matter in great detail, leading up to the following conclusion. It seemed to his Lordship that the question of the plaintiff's right entirely depended upon whether there was any general agreement approved between the parties to the effect that whatever shape the scheme eventually took and however the company was formed which should work the patents, they should share the profits that should be made out of the whole matter. It was quite clear to him (the Judge) that with regard to the Cornwall and Wales original scheme, the plaintiff and Mr. Willard were to share the profits equally, and in his opinion that agreement did not extend to the subsequent project and arrangements. It was an agreement made solely with regard to the Welsh scheme, it was made between the plaintiff and Mr. Willard only, and it did not include or concern Mr. Stalmann and Mr. Haviland, who were the other defendants, and when the Welsh scheme came to an end, his Lordship was of opinion that that agreement also ended. So that the only question that remained was—Was there an agreement between the parties, that, however the matter was carried out, they should all share in the profits; did an agreement exist by which these persons should work together for the purpose of putting the invention on the market, and forming a company and share the profits? This was the claim made in the third paragraph of the plaintiff's statement of claim, and the suggestion in brief was that in January, 1911, it was verbally agreed between the plaintiff and the defendants that they should become partners, and work together for the purpose of forming the company, and all the profits to be derived should be shared between them. In order to succeed in that action plaintiff had to establish an agreement of that nature. His Lordship was of opinion that there could be no doubt that the idea was, and the understanding was, if one might call it so, that they were all to share in that way; but, of course, one could not sue upon the strength of an understanding or an idea, and he (the Judge) had to find, if the agreement was proved to the effect and substance of that which he had referred to, and he was bound to say, with some measure of regret, that he did not think there was such an agreement. The plaintiff had given his evidence on the matter extremely fairly, but he could not find that the plaintiff's evidence came to anything approaching such an agreement as this. He said it was arranged that he and Mr. Willard were to divide the profits equally in the Cornish scheme, and then he said matters developed about the Newcastle project, but no agreement was made there about the profits, and his Lordship could not find in the plaintiff's examination in chief that he established any further agreement with regard to Newcastle until he came to the matter which was mentioned in the postcard of August 19th, and that, to his Lordship's mind, upon the face of it, and upon the evidence entirely, proceeded upon the basis of the option being given to the plaintiff. That was the only way the scheme could be carried out, if such an agreement as was contended for, was made. Plaintiff had also said in cross-examination that he took it for granted, that there was some arrangement as to profit, in connection with the Newcastle scheme, but nothing was really said about it. He (the Judge) was satisfied that upon all the evidence, he could not find any such agreement as was alleged, and which must be proved in order to sustain the action. Nor could his Lordship entirely disregard the evidence in contradiction of the plaintiff's testimony given by Mr. Willard and Mr. Haviland; the evidence of these gentlemen was in absolute contradiction of the somewhat loose and vague statements concerning the agreement made by the plaintiff. Nor could he disregard the evidence of Mr. Stalmann and Mr. Ruthenburg as to what took place at the interview at which they were all together in London, and at which Mr. Ruthenburg declined to renew the option to the plaintiff. He could not find any agreement involving a general sort of partnership, using the word in the ordinary sense, and no agreement to share profits however the matter was carried out, and if he could not find that, plaintiff could not succeed. He thought there was an idea and a

scheme making such a provision, but that scheme fell through, and when the scheme fell through, the agreement fell through, and unless there was a general agreement to share profits to fall back upon, he did not think there was anything upon which the plaintiff could sue, and as there was no such general agreement, the plaintiff's case failed. He regretted this, because it did seem rather hard on the plaintiff. He was not going to say whether it was the failure to find capital, or whether he got into connection with persons of greater astuteness than himself; it was not necessary for his Lordship to express an opinion on this, but it did seem hard on plaintiff, considering that he had brought the matter to the notice of these gentlemen, and he regretted he was unable to find that plaintiff was entitled to anything in respect to the matter. However, he (the judge) could not find the agreement was proved. He thought the only answer plaintiff gave to go to anything like such an agreement was inconsistent with his other answers, and was inconsistent with the evidence of the others, and therefore he gave judgment for the defendants, with costs.

MR. PATRICK HASTINGS (counsel for the plaintiff) said that, with regard to the question of costs, he wished to point out that in view of the fact that the case for the plaintiff here was that the defendants went behind his back and did certain things surreptitiously, it was most important that they should have had proper "discovery," but this proper "discovery" was not in fact given, and he asked his Lordship to say that, under these circumstances, the plaintiff should not be entirely mulcted in the costs of the action.

MR. JUSTICE PICKFORD replied that he would like to accede to the application of Mr. Hastings, but he could not do so.

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PLAYER *v.* CROMPTON & CO., LTD.

THIS case, which was a debenture-holder's action, was again mentioned to Mr. Justice Warrington in the Chancery Division on Friday, upon a motion for a Receiver.

MR. CLAUSON, K.C., for the plaintiff, said Mr. Younger, K.C., was on the other side, but was engaged elsewhere, and subject to his Lordship's sanction, they had agreed that the motion should stand for another week. Counsel also mentioned that the motion raised a point of law.

His LORDSHIP assented.

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BUFFALO FORGE, &C., CO., LTD., *v.* BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., LTD.

IN the King's Bench Division, on Friday, February 13th, an application was made to Mr. Justice Pickford in this non-jury action.

MR. HAROLD MORRIS, for the plaintiffs, applied that the case should be allowed to stand out till the 26th inst., keeping its place in the list in view of the fact that the parties were negotiating for a settlement.

MR. JUSTICE PICKFORD asked if counsel thought that the negotiations would prove effective, and counsel replied that he was instructed that an offer had been made and was being considered.

MR. JUSTICE PICKFORD: You really think it will come to something?

COUNSEL: Yes, I do.

His LORDSHIP then assented to the application.

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STOLZ ELECTROPHONE CO. (1913), LTD.

THE petition of A. Hyman for a compulsory order to wind up Stolz Electrophone Co. (1913), Ltd., came before Mr. Justice Astbury in the Companies' Winding-Up Court on Tuesday, 17th inst.

COUNSEL for the petitioner said he was a debenture-holder for £171, and a shareholder for £31,000. A large number of persons present consented to the order. Mr. Ashton Cross said everybody desired a winding up, but the petitioner was not a creditor.

COUNSEL for the petitioner said in his affidavit he explained how he came to be a creditor and shareholder.

MR. MANNING and other counsel for creditors supported the petitioner, but desired another petitioner to be substituted for Mr. Hyman.

His LORDSHIP said it was quite immaterial if he made an order.

COUNSEL for the company submitted to an order.

His LORDSHIP ordered the company to be wound up compulsorily.

## PARLIAMENTARY.

*Petitions Against Private Bills.*—Amongst the petitions which have been deposited in the Private Bill Office of the House of Commons in opposition to Private Bills, are the following:—

London Electric Supply.—St. Marylebone B.C.; Hammersmith B.C.; City Corporation; Charing Cross, West End and City Electricity Supply Co.; Brompton and Kensington Electric Supply Co.; South Metropolitan Electric Light and Power Co.; City of London Electric Co.; London County Council; and Woolwich B.C.

Metropolitan and Great Northern Railways Companies.—St. Marylebone B.C.; Port of London Authority; Hammersmith B.C.; City Corporation; Finsbury B.C.; London County Council; and a large number of private owners of property.

Central London Railway.—Hammersmith B.C.; Westminster City Council; Gas Light and Coke Co.; L.C.C.; Holborn B.C.; and others.

L.C.C. Tramways.—Port of London Authority; Westminster C.C.; City Corporation; London General Omnibus Owners' Federation; Metropolitan District Railway Co.; London United Tramways Co.; and a number of frontagers.

London Electric Railway.—Westminster C.C.; Holborn B.C.; and the L.C.C.; and others.

Deal and Walmer Gas and Electricity.—Sandwich Corporation; South-East Kent Electric Power Co.; East Kent Light Railway Co.; Deal Corporation, &c.

Leyland Gas and Electricity.—Leyland U.D.C.; and West Lancashire R.D.C.

London United Tramways.—Ealing Corporation; and the U.D.C.'s of Twickenham, Teddington, Hampton Wick, and Heston and Isleworth; Middlesex C.C.; Wimbledon Corporation, &c.

Lurgan Gas and Electricity.—Armagh and Down County Councils and the Lurgan U.D.C.

Oxford and District Tramways.—Oxford Corporation and Oxford Gas Co.

Norwich Electric Tramways.—The Dean and Chapter of Norwich Cathedral and others.

Alliance and Dublin Consumers' Gas (Electric Supply).—Dublin Corporation; U.D.C.'s of Kingstown, Blackrock and Dalkey; and the Dublin Southern District Electric Supply Co.

Sheffield Corporation.—Yorkshire Electric Power Co., and others.

South Suburban Gas.—West Kent Electric Co.

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**Street Accidents.**—Replying to Mr. F. Kellaway, the Home Secretary states that in 1913 there were 608 street accidents in the Metropolitan area during 1913. Tramcars caused 58 and motor-'buses 180.

**Second Readings.**—In the House of Commons on Tuesday, according to the *Times*, the following Bills were read a second time:—Alliance and Dublin Consumers' Gas (Electric Supply) Bill, Central London Railway Bill, Deal and Walmer Gas and Electricity Bill, Leyland Gas and Electricity Bill, London Electric Railway Bill, and the London United Tramways Bill.

## BUSINESS NOTES.

**Catalogues and Lists.**—MESSRS. CROMPTON & CO., LTD., Chelmsford.—Leaflet No. 506, just issuing, gives an illustrated description with tabulated prices of pedestal pattern moving coil and moving iron instruments for A.C. and C.C.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—Four-page list No. 4,502, containing a full illustrated description of their compression chamber multi-gap lightning arrester for alternating currents, and its construction. Prices are tabulated and dimension drawings given.

ALLGEMEINE ELEKTRIZITATS GESELLSCHAFT, Berlin.—Leaflets illustrating medical apparatus, hair-drying blowers, and portable agricultural machines.

THE A.E.G. ELECTRIC CO., LTD., 133-135, Oxford Street, London, W.—Illustrated circular relating to their "Nitra" half-watt lamps which are now manufactured with a current consumption of 100, 200 and 400 watts.

MESSRS. ALFRED HERBERT, LTD., of Coventry, have again issued one of their very clearly printed calendars for the year, with monthly sheets.

SCHIERSTEINER METALLWERK G.M.B.H., Swerinstr. 3, Berlin W. 57.—Leaflets relating to the "Veritas" relays for signalling purposes, for use in conjunction with electric clocks as time switches.

MESSRS. MELDRUM BROS., LTD., Timperley, Manchester.—Thirty-two page catalogue containing a description of their coking and sprinkler type mechanical stokers, their design and construction, with illustrations of parts and pictures showing them applied to a number of plants. Tabulated results of tests are also given.

THE ADNIL ELECTRIC CO., LTD., Artillery Lane, London, E.C.—List T 75 (8 pages) containing a fully-illustrated description of the Adnil mine shaft signalling system, which has been made to comply with the new Mining Regulations.

MESSRS. W. MCGOWING & CO., 239, High Road, Leyton, London, E.—Price list of steel sheeting, metal flange covers, and non-conducting coverings.

BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., LTD., 14, Long Millgate, Manchester.—Pamphlet announcing reduced prices of Auriga wire-drawn lamps.

THE METALLIC SEAMLESS TUBE CO., LTD., Meta House, Corporation Street, Birmingham.—Postal price-card relating to fuse and distributing boards.

**Extension of the Pirelli Cable Works in Spain.**—Messrs. Pirelli & Co., of Milan, have lately acquired a large area of land adjoining their Spanish branch electric cable works at Villanueva y Giltru. Two large new buildings, having a total floor space of 5,600 sq. metres, are being erected, one being intended for the production of rubber goods, and the other for the manufacture of telephone cables.

**Rubber Exhibition.**—We have received a copy of the official bulletin of the fourth International Rubber and Allied Industries Exhibition that is to be held in June next at the Agricultural Hall, London. It contains information concerning the rubber congress, and matters of general interest to exhibitors.

**Book Notices.**—*Phase Compensation* (Part I) is the title of a brochure which we have received from Mr. Val A. Fynn, consulting engineer to the Wagner Electric Manufacturing Co., of St. Louis, U.S.A., and which contains an amplified reprint of articles which he published in the *Electrical World* in July last year. The author reviews the nature of a phase difference, and its effects on the generating and consuming apparatus, indicates how it is produced, and shows how it can be controlled in A.C. motors. Part I especially deals with the control of the power factor of a single-phase motor; the author finds that the power factor in any A.C. motor can be controlled, within the widest limits, by changing the phase of the exciting flux relatively to the phase of the working E.M.F., and describes methods of carrying out the necessary compensation.

*Automatic Telephony.* By S. Turner. London: S. Rentell & Co., Ltd. Price 6d. net.—This is a reprint of articles which appeared in *Electricity* last year dealing with the system of the Automatic Electric Co., of Chicago, which is in use in some of the Post Office exchanges in this country. The system is described in detail, and the successive operations necessary to connect any two subscribers in a three-figure exchange are traced out, with the aid of numerous diagrams. The author's object is very successfully accomplished, and anyone who desires to become acquainted with the working of the system in question will find this little book a clear and inexpensive guide to the attainment of his ambition.

*The Engineer's Year-Book* of Formulæ, Rules, Tables, Data, &c., for 1914. By H. R. Kempe, M.Inst.C.E. London: Crosby Lockwood & Son. Price 15s.—This year we have the pleasure of congratulating the Editor and publisher of "Kempe's Year-Book" upon the attainment of its majority; for this is the twenty-first year of publication. Fittingly to mark the occasion, the book has been revised and amplified with greater thoroughness than in any previous year, the new matter introduced occupying a space equivalent to more than 200 pages. Corrections and excisions have been made with a drastic pen, to maintain the reputation of the work as the standard of information on modern engineering practice. The total number of pages is now 1,800, but by systematic sectionising and sub-division—which has been reorganised and extended in this edition—the various subjects are made easy of reference. New sections deal with machine tools and power transmission; the sections on mining, rainfall and irrigation have been largely rewritten, and other new sections have been added on the cost of engineering works, link motions and valve gear, and the arrangement and construction of engineering workshops. The Editor has had the assistance of a large number of expert contributors, and enjoys special privileges conferred upon him by various public bodies which have enabled him to include much valuable information. To review such a work would not only be a gigantic task, but would also necessitate the collaboration of a small army of specialists; moreover, it is superfluous in the case of a tried and trusty friend of 21 years' standing. As we have said before, those who know the book will welcome the new edition; those who don't know it, ought to.

In addition to a number of other matters, the February *Journal* of the Tramways and Light Railways Association contains a list of members and their addresses.

"*Journal* of the Institution of Electrical Engineers." Vol. 52, No. 228. February 16th. London: E. & F. N. Spon, Ltd. Price 3s. 6d.—This issue contains papers on "Some Railway Conditions Governing Electrification," by R. T. Smith, and "Suggested Methods for Improving the Telephone Service," by W. Aitken.

"Applications of Electricity." By A. Ogilvie. London: T. C. and E. C. Jack. Price 6d. net.

"*Journal* of the Western Society of Engineers." Vol. XVIII, No. 10, December, 1913. Chicago: The Society. Price 50 cents.

"*Journal* of the Franklin Institute." Vol. CLXXVII, No. 2, February. Philadelphia: The Institute. Price 50 cents.

"*Transactions* of the Institution of Engineers and Shipbuilders in Scotland." Vol. LVII, Part IV, February. Glasgow: The Institution.

"A Preliminary Report on Uranium, Radium and Vanadium." By R. B. Moore and K. L. Kithil; "Copper Wire Tables," and "Standard Specifications for Electric Lamps." Washington: Government Printing Office.

"The Physical Review," Vol. III, No. 1, January. Lancaster, Pa.: The American Physical Society.

"Handbuch der Elektrizität und des Magnetismus." By Prof. Dr. L. Graetz, 2 vols. Leipsic: J. A. Barth. Price 10 m. each.

"*Bulletin* de la Société Internationale des Electriciens." Vol. IV. No. 31, January. Paris: Gauthier-Villars et Cie. Price 2 fr. 50.

"*Giornale* ed Atte della Associazione Elettrotecnica Italiana." Vol. I, No. 2, February 15th. Milan: The Association. Price L1.

**Electric Welding.**—A new company has just been formed in Antwerp with a capital of £6,000, and the title The Belgian-Swedish Electric Welding Co., to develop a new electric welding process.

**Dissolutions and Liquidations.**—Hoveler's Liquid Fuel Appliances, Ltd.—This company is winding up voluntarily, with Mr. H. Freericks, of Tandem Buildings, Merton Abbey, S.W., as liquidator.

The Kent Electric Power Syndicate, Ltd.—This company is winding up voluntarily, with Mr. F. A. H. Walker, of 2A, Railway Street, Chatham, as liquidator. A meeting of creditors was held at 7, St. Helen's Place, E.C., on Saturday last.

Thompson & Co., electrical and mechanical engineers, 15 and 16, Garlick Hill, E.C.—Messrs. F. Thompson and H. Ochsenbein have dissolved partnership from December 31st last. Mr. H. Ochsenbein will attend to debts.

Brighten, Malcolm & King, Ltd.—This company is winding up voluntarily, with Mr. W. Lambert, of Dock House, Billiter Street, E.C., as liquidator.

**Bankruptcy Proceedings.**—W. R. Wedge, electrical engineer, The Arcade, Northampton.—The adjourned public examination of this debtor took place at the County Hall, Northampton, last week, when it was reported that he was still employed at Bury, Lancashire, but there were possibilities that in the near future he would have more convenience for attending the Court. The case was therefore again adjourned.

J. G. M. Hilton, electrical engineer, Birmingham.—The first dividend of 3s. in the £ is payable on February 23rd, at the Official Receiver's office, Ruskin Chambers, 191, Corporation Street, Birmingham.

F. W. Suter, engineer and company director, 67, St. John's Park, N.—Application for debtor's discharge to be heard March 10th, at Bankruptcy Buildings, Carey Street, W.C.

**For Sale.**—Messrs. John Thomas, Jun., & Co. have for disposal the whole plant of the Newport Rolling Mills, Middlesbrough, including the electrical installation, particulars of which will be found in our advertisement pages.

**Trade Announcements.**—Messrs. J. Lomax-Kendal Co., Ltd., electrical engineers, of Manchester, are terminating their agency for Easton lifts in the Manchester district about the end of April.

Messrs. George Ellison, of Birmingham, have appointed Messrs. Nathan & Allen, of Queen Anne's Chambers, Westminster, as their London Agents.

**Amalgamation.**—According to reports in the Press, negotiations are on foot for the amalgamation of Stewarts and Lloyds, Ltd., and the Scottish Tube Co.

## LIGHTING and POWER NOTES.

**Aberdeen.**—New Plant.—The Electricity Committee has decided to provide an additional 1,000-kw. motor-converter to transform the three-phase 6,000-volt supply for lighting and traction purposes, in place of the two sets which are going to Rubislaw and Broadford works; it was stated that a saving of £430 per annum would be effected. The Committee has also decided to augment the present water supply by obtaining a supply from the Dee.

**Amersham.**—Workhouse Lighting.—The B. of G. has asked the Chesham E.L. Co. to submit an estimate for the installation of E.L. at the workhouse.

**Argentina.**—An application has been made to the La Rioja Government for a concession for electric light and power in La Rioja.

The Ministry of the Interior has been authorised to expend $10,000 m/n. on the purchase of electric lighting and heating material for its new offices.—*Review of the River Plate.*

**Australia.**—The Brunswick (Vic.) Council has decided to borrow £7,000 for electric lighting purposes.—*Tenders.*

**Ballachulish.**—Electricity Works Fire.—According to the *Glasgow Daily Herald* the electricity works and gas engine house of the Ballachulish State Quarries were completely destroyed by fire on the morning of February 13th. Incendiarism is suspected.

**Ballater.**—E.L. Scheme.—Owing to the opposition of the Dee Fishery Board to the water power scheme, the promoters have now decided to install a suction gas plant.

**Barnes.**—Cottage Lighting.—The D.C. has decided to charge 2d. per 30-watt lamp per week for E.L. in the cottages being erected in the Malthouse area, including the supply of lamps in the first instance, all other lamps being found by the tenants. The wiring and fitting is to be carried out by the electricity department.

**Birmingham.**—A new electric power plant has recently been installed at the works of the Austin Motor Co., Ltd., at Northfield, by the Anderston Foundry Co., of Glasgow. It consists of two vertical four-cylinder gas engines of 200 H.P. each, coupled direct to 175-kw. alternators by the Allmanna Svenska Electric Co., of Stockholm. The current generated is distributed to 16 20-H.P. motors located in various machine sections of the works, and also for lighting purposes.

**Basingstoke.**—Loan Sanction.—The L.G.B. has sanctioned loans for the E.L. scheme, and tenders are to be invited for buildings, &c.

**Bitterne.** — E.L. Scheme.— A parish meeting has decided against the proposal of the Council to adopt the Lighting Act—with a view to entering into an agreement with Southampton for public electric light—and a poll of the electors is to be taken on the subject.

**Blackrock.**—The petition which the U.D.C. has lodged against the Alliance and Dublin Gas Consumers' Electric Supply Bill states that the Council has itself an E.L. scheme under consideration in conjunction with neighbouring local authorities, and submits that the powers sought by the Bill are in breach of an agreement made between the Council and the company in July, 1913. The petition also objects to overhead wires.

**Bo'ness.**—The T.C. has decided to defer consideration of the taking over of the electricity works from the National Electric Construction Co. until the next break in the agreement, four years hence.

**Canada.** — Hydro-Electric Breakdown.—According to the *Electrical World*, the electric service of the Power Commission, extending from Niagara Falls to Toronto in the North, and to London and St. Thomas in the West, about 420 miles of H.T. and 20,000 miles of L.T. lines, was interrupted for 8 hours on January 31st, by a local hurricane, which snapped two of the ice-covered wires, which, falling across others, short-circuited the line. The delay was due to trouble in locating the break. Severe inconvenience was caused in Toronto, where the streets are exclusively lighted from the Hydro-Electric system; the civic tramways were also shut down, and other towns were more or less similarly affected. It is understood that a second line, to contain two circuits, has been surveyed between Dundas and Niagara Falls, and this will be of extra heavy construction, employing an aluminium conductor reinforced by steel.

Over 150 representatives of towns using the Hydro-Electric service have petitioned the Commission to develop a durable standard electric range of moderate cost, and to manufacture this for the various municipalities, who believe there is a great opening for such a stove, especially among the farmers.

**Carlisle.**—The T.C. has decided to supply E.L. to Scotby, which is from 2 to 3 miles from the centre of the city; the proposal was opposed by the Gas Committee.

**Continental Notes.**—Turkey.—La Société Anonyme d'Electricité Ganz, of Budapest, is installing a modern central station in Constantinople for lighting and power service. Hitherto, according to the *Electrical World*, only a few private plants in hotels, offices, &c., have been in use.

France.—We hear that the Paris, Lyons and Mediterranean Railway Co. is carrying out some tests of a number of different train electric lighting systems, including several of British design.

**Crook.**—Proposed E.L.—The U.D.C. has decided to consider the question of an E.L. scheme for the town.

**Croydon.**—The price of electricity supplied to the tramways department for traction purposes is to be fixed at ¾d. per unit for all beyond two million units per year. Electric light is to be installed in the depôts of the highways department in lieu of gas, at an estimated cost of £240. It is estimated that the current will cost £8 17s. 6d. a year, as against £16 14s. for gas. The General Purposes Committee is considering a new system of fire alarms.

**Curragh Camp.**—The War Office has undertaken to supply E.L. to the Camp, where extensive developments in business premises are taking place.

**Dundee.**—New Plant.—The Electricity Committee requires additional converting plant, boilers, and coal-handling plant for the Carolina Port generating station, and at a meeting the Convener suggested that the engineer and himself be empowered to negotiate privately for the necessary plant. The engineer expressed the opinion that, owing to the combination of the manufacturers of electrical generating plant, this would be the cheapest course. A member remarked that they had the same trouble in connection with the cables some years ago, and on that occasion they went to the Continent and got them cheaper. The Convener's suggestion was agreed to.

**Ellon (Aberdeenshire).**—E.L. Scheme.—The T.C. is practically assured of the requisite support for the E.L. scheme, and is now looking out for a site for a generating station.

**Failsworth.**— Street Lighting. — Sixteen electric lamps are to be installed in Oldham Road by the Manchester Corporation at an annual rental of £3 15s. per lamp.

**Farnham.**—The Slough and District E.S. Co. is arranging to supply electricity to Farnham in the autumn of the present year.

**Flint.**—Proposed E.L.—Mr. A. J. Leigh, of Northwich, is to make an inspection of the town, and report on the question of E.L. there.

**Glasgow.** — Hiring-out Proposals.—The Electricity Committe has appointed a sub-committee to report on the advisability of the electricity department hiring out cooking, heating and other appliances.

**Glass Houghton.**—Proposed E.L.—The P.C. has decided to communicate with the manager of the West Riding Tramways Co., with a view to the preparation of a scheme for the E.L. of the district.

**Gravesend.** — Loan Sanction, New Plant, &c.— The T.C. has received sanction from the L.G.B. to a loan of £800 for services.

The Council has decided to invite tenders for additional plant for the electricity works.

**Great Yarmouth.**—Loan Sanction.—The T.C. has received the sanction of the L.G.B. to a loan of £7,639 for electricity purposes.

**Halifax.**—New Plant Inaugurated.—At the starting-up of the new 3,500-kw. turbo-alternator, which has been installed at a cost of £11,310, Mr. A. Fawcett said that before very long they would have to look out for a site for the erection of new electricity works, using the present works as a sub-station. During the past two years the output from the works had increased by two million units, and if that rate of progress was maintained, further plant would be required.

**Harrogate.** — Loan Sanction. — The T.C. has received the sanction of the L.G.B. to loans, as follows:—Electricity works extensions, £5,239; H.T. mains, £1,000; and L.T. mains and transformers, £1,400.

**Holywell.**—Workhouse Lighting.—The B. of G. has reversed a decision of a Committee that gas shall be the illuminant for the workhouse and new infirmary, and has decided to use electricity

**Huddersfield.** — Annual Accounts. — The financial statement of the Corporation electricity undertaking for the year ended December 31st last, shows that the income was £49,886, compared with £45,078 for the previous year. The expenditure amounted to £31,671, and the surplus to £18,216, compared with £28,511 and £16,567 respectively for 1912. Interest absorbed £7,245, redemption of debt £5,640, and the amount repaid to the Public Works Board was £1,696; £1,585 has been transferred to the depreciation and contingencies account, which stands at £8,213, and £2,050 to the relief of rates.

**Ipswich.**—L.G.B. Inquiry.—An application by the T.C. to borrow £37,500 for electricity purposes was inquired into by Mr. H. R. Hooper last week. The loan was required for the following purposes:—Mains, £21,000; services, £3,000; motors, £4,000; works already carried out, £1,700; plant, £6,150; sub-stations, £1,200. There was no opposition, but the Inspector questioned the wisdom of the expenditure on motors.

Proposed Loan.—The T.C. has decided to apply to the L.G.B. for sanction to borrow £4,000 for the purpose of erecting a sub-station to supply current to a district which will include the Orwell Works of Messrs. Ransomes, Sims & Jefferies, who have agreed to take 100 H.P. for seven years. It is proposed to install two 250-kw. converters and switchgear.

**Keith.**—Proposed E.L.—The T.C. has instructed the Lighting Committee to report upon the question of introducing an E.L. system into the town.

**Kingstown (Co. Dublin).** — Prov. Order. — The U.D.C. has resolved to apply to the B. of T. for the renewal of the prov. order granted to the Council in 1896, which was revoked in 1904 or, alternatively, to grant a prov. order to enable the Council to supply electricity within its area.

It was also decided to appoint a Committee, with powers to act, to consult with the law agent in reference to the E.L. Bills at present before Parliament.

**Largs.** — Proposed E.L. Scheme. — The T.C. has decided to obtain a report from an engineer on the cost of a power station, a lighting scheme for the promenades, and the price at which electricity might be supplied to consumers.

**Leigh.**—A proposal is being made that the gas and electricity departments of the Corporation should take a joint showroom to exhibit gas and electrical appliances.

**Liverpool.**—The Corporation is now sterilising by electricity the whole of the milk for infants supplied to the public from the various Corporation milk depôts in the city.

**London.**—The Fulham and Shoreditch B.Cs. have decided to oppose the London Electric Supply Bill, 1914.

**Preston.** — Street Lighting.—The authorities are reported to have made up their minds as to the superiority of gas, as compared with electricity, for street lighting. A few years ago a trial was given to electric light in Deepdale Road, and last winter Stanley Street was on alternate nights illuminated by high-pressure gas and electricity. Arrangements are now in progress to again test the high-pressure gas system.

**Manchester.**—On Saturday a new electrical street lighting scheme was inaugurated, similar to that adopted in Portland Street. In Stretford Road 45 11-ampere flame arc lamps have been erected, and these will be automatically lighted and extinguished by a clock. A similar installation is to be adopted in Oxford Road and Peter Street, extending from Deansgate to Fallowfield Station. Altogether, there will be 11 miles of important thoroughfares lighted in this manner as the outcome of the test made some time ago between the merits of gas and electricity.

**Plymouth.**—Public Lighting.—The B.C. has instructed the Electricity Committee to prepare alternative estimates for the lighting of the Embankment by gas and electricity.

**Reading.**—The T.C. has decided to object to the application of the Reading E.S. Co. for a prov. order to supply electricity in bulk to the York Town and Blackwater Gas Co., on the ground that the Council's powers to purchase the E.S. Co.'s undertaking would be prejudiced.

**Rhyl.**—L.G.B. Inquiry.—Mr. T. C. Ekin held an inquiry on the 10th inst. into the application of the U.D.C. for permission to borrow £3,900 for extensions at the electricity works. The loan has, we understand, been sanctioned.

**Romford.**—The County of London E.S. Co. having undertaken not to seek in its Bill to interfere with the powers of the Council in regard to that portion of the undertaking authorised under the Romford and District E.L. Order, 1913, and situated in the area of the R.D.C., the Council has decided not to oppose the Bill.

**Sandwich.**—The T.C. has decided to oppose the Gas and Electricity Bill of the Deal and Walmer Gas Co.

**Sligo.**—Asylum Installation.—The Sligo and Leitrim Asylum Committee has approved of its engineer's report recommending that the institution be lighted by electricity, that a new power house be erected, and that two 20-B.H.P. gas engines with direct-coupled dynamos, as well as suitable suction gas plant in duplicate, be installed.

**Southport.**—Cottage Lighting.—Last week the T.C. adopted a revised scale of charges for electricity, including special terms for cottage property; the Corporation, through contractors, is to install lights at 7s. 6d. each with a minimum of three, the charge to be 1½d. per lamp per week if paid monthly in advance, and 2d., if paid weekly in advance.

**Stirling.**—Proposed E.L. Transfer.—The T.C. has decided that the offer of £32,000, made by Mr. George Balfour, for its electricity undertaking, would not compensate it for the "ultimate disadvantages consequent upon the transference of the undertaking from public to private control."

**Swansea.**—Rate Relief.—During the past two years the Corporation electricity department has contributed £2,200 to the relief of rates, and at last week's meeting of the Finance Committee the amount that could be allocated out of the current year's profits was discussed. The vice-chairman of the E.L. Committee opposed any allocation, and pointed out that the Committee was faced with a further outlay of £40,000 for extensions, which would be unremunerative for some time. They had increased working costs, the assessments had gone up, and the price of current had been reduced. The Swansea undertaking had only £8,000 in the reserve fund. The borough treasurer said some of the additional outlay would be at once remunerative, although at the same time he would not advise the Committee to transfer so much as in past years. He could not agree that placing 10 per cent. to reserve meant that it must be placed all at once, and if they reached 10 per cent. in 25 years, it would be doing more than a great many electrical concerns had done. It was decided to recommend the Council to allocate £700 towards the relief of the rates.

**Swindon.**—School Lighting.—The Education Committee is to consider the E.L. of the schools in the borough at present lighted by gas.

**Swinton and Pendlebury.**—A proposal has been made for utilising the steam generated at the Pendlebury refuse destructor in connection with the electric lighting of the adjacent main roads.

**Taunton.**—Street Lighting.—A new system of street lighting, which has proved very satisfactory, has just been completed. The lights are centrally-suspended, and tungsten lamps have been adopted, the arc lamps having been replaced by groups of five Osram lamps.

**Trimdon.**—The P.C. has decided to carry out a scheme of public E.L. at Trimdon Grange and Trimdon Colliery villages by means of overhead cables.

**Truro.**—E.L. Scheme.—At a meeting of the T.C. last week, the E.L. Committee reported that a letter had been received from the Cornwall Electric Power Co., setting out terms upon which it would be prepared to supply electricity in bulk to the town. Mr. L. A. Hurds, the manager of the company, and Dr. J. Purves attended the meeting. Mr. Hurds undertook to ascertain whether the company would be prepared to enter into a contract for 42 years instead of 21 years, with an option for the Council to determine the same at the expiration of the fifteenth or any subsequent seven years, to reduce the charge per KW., to obtain at its own expense the wayleaves from Devoran to Truro, and to agree to a penalty clause being inserted in the contract in the event of a defective supply of electricity. The report was adopted.

**Turriff.**—Proposed E.L.—The T.C. has appointed a committee to consider the question of E.L. for the town.

**U.S.A.**—A 425-Mile Transmission Scheme.—It is reported in the *Electrical World* that the Coachella (Cal.) Co. is to purchase energy from the Southern Sierras Power Co., a 35-mile transmission being built to connect to the latter company's lines; from Coachella a 150-mile line will be built to the Holton Power Co.'s system at El Centro. The total distance from the Bishop Station of the Southern Sierras Co. to El Centro is 425 miles, representing the longest transmission in the world, which will work at 55,000 volts.

**Warrington.**—L.G.B. Inquiry.—An inquiry was held on the 12th inst. into the application of the Corporation to borrow £14,551 for extensions of the electricity works and plant.

**Watford.**—Prov. Order.—The R.D.C. has decided not to oppose the Colne Valley E.S. Co.'s application for a prov. order for electric light.

The U.D.C. has requested the local Member of Parliament to support the Bill of the I.M.E.A.

**West Hartlepool.**—Proposed Loan.—The T.C. is to apply to the L.G.B. for sanction to borrow £2,000 to cover the expenditure on the "waste heat" scheme in excess of the loan sanctioned, and £2,300 for additional cables.

The sub-committee in charge of the scheme has been instructed to report on the contract with Richardsons, Westgarth & Co. for the supply of plant to the new power station.

**West Yorks.**—E.L. Proposals.—The Huddersfield and Brighouse T.Cs., and the Horbury, Todmorden, Southowram and Holmfirth Councils, have decided to oppose the Yorkshire Electric Power Co.'s Bill, while the Otley, Lepton and Drighlington U.D.Cs., and the Barkisland R.D.C., have decided to support it.

**Weymouth.**—The T.C. has decided to request the local Member of Parliament to support the Bill of the Municipal Electrical Association.

**Whitworth (near Rochdale).**—E.L. Scheme.—An electricity scheme, estimated to cost from £11,000 to £12,000, is contemplated.

**Willington (Co. Durham).**—E.L. Scheme.—The U.D.C. has been informed by the contractors for public lighting by gas at Oakenshaw, that they are considering a scheme for supplying that part of the district with electricity in the near future.

**Windsor.**—Sewage Pumping.—The past year's experiment of using electricity for pumping at the sewage works has proved so satisfactory and economical that the T.C. proposes to purchase the plant from the Windsor Electrical Installation Co., which is to be asked at what price it will supply current in the event of the plant being bought by the Corporation.

**Yeovil.**—Prov. Order.—The T.C. has consented to the prov. order for the supply of electricity to the town which Messrs. Petters, Ltd., are applying for.

## TRAMWAY and RAILWAY NOTES.

**Bolton.**—The Tramways Committee has approved of an estimate and design for the fitting up of an electric luggage car, and has given instructions for the work to be carried out.

**Brighton Railway Electrification.**—The report of the company for 1913 states that the major portion of the expenditure of £99,418 was incurred in the electrification of its suburban system. Good progress is being made with the first section put in hand, from Balham to Wallington, *via* West Croydon. A contract for the additional rolling stock has been made, and deliveries will commence during this year.

**Cardiff.**—The proposed tramway extension to Llandaff Field Gates has been deferred. The engineer has been asked to report on the cost of extending the system to Gabalfa. The estimated expenditure for the coming year is £151,148, and the income £163,555.

**Continental Notes.**—Germany.—Since the beginning of 1912 43 battery-driven coaches have been put in service on the Prussian-Hessian State Railways, 20 being able to run a distance of 80 miles and 23 112 miles on one charge.

Electric Cabs.—Out of 2,437 taxi-cabs in use in Berlin, 475 are of the electric type. In Hamburg the electric cabs outnumber the petrol variety, the figures being 184 and 128 respectively, while in Bremen they number 14 and one respectively.

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Licences are being obtained in Berlin for a large fleet of accumulator omnibuses, and the movement is regarded favourably by the authorities. An independent company has been formed for this purpose. The Underground Railway Co. controls the existing petrol and horse 'buses; the former are few, and much inferior to the London vehicles.

Belgium.—A tramcar collided with a wagon in Brussels on Monday; the conductor was killed, and 10 passengers were injured.

Spain.—Application has been made for a concession for the construction of electric tramways in the Seville district.

Switzerland-Italy.—According to the *Electrical World*, an electric 'bus service has been established across the Alps between Airolo, Switzerland, and Ulrichen, Italy; the route is *via* the Nufenen Pass, and the trip takes 1¾ hours, 22 passengers being carried.

**Dundee.**—Proposed Tramway Extensions.—The tramway manager has under consideration several schemes of tramway extension, involving an expenditure of approximately £8,000.

**Ealing.**—The T.C. has decided to oppose the London United Tramways Bill.

**Huddersfield.**—Tramway Extensions.—The Tramways Committee has decided to double the track on the Outlane, Fartown, Longwood and Leeds Road sections, and then to carry out the Greetland and Marsden extensions. The Electricity Committee has been asked to supply the electricity required between the present terminus at Slaithwaite and the proposed terminus at Marsden, and all further extensions are to be dealt with in the same way.

The Newmill U.D.C. has asked the Corporation to extend the tramways and electricity supply to the district; the matter has been referred to the Electricity Committee.

**Lanarkshire.**—New Tramway Opened.—The extension of the Lanarkshire tramways from Uddingston Cross to Bellshill Cross was opened last week, following an inspection by Major Pringle.

**London.**—An accident, in which a driver was killed and several passengers were injured, occurred at Harringay on Tuesday evening. A car going down Manor House Hill apparently got out of control, and dashed into the one in front, both cars being severely damaged.

Electric Dust Cart.—The St. Marylebone B.C. has purchased a 5-ton F.R.A.M. electric vehicle for refuse collection; according to the *Financier*, the Southampton and Edinburgh T.C.'s are awaiting demonstrations of this vehicle before following suit.

**Newcastle-on-Tyne.**—Estimates for 1915.—The estimates for the Corporation tramway undertaking for the year ending March, 1915, show an income of £255,150, as compared with £233,645 receipts for the current year. The expenditure is estimated at £144,900, as against £133,500 for the past year. The estimated gross profit is £110,250, against £100,145, and the net profit £32,800. It is estimated that £34,256 will be spent out of the reserve and renewals fund, including alterations to cars, £6,000; new pipe line, valves, &c., at pumping station, £2,500; removing and renewing centre poles, £3,200; water softener, £400; additional turbine, £9,200; additional rotary converter, &c., £2,550. The expenditure on renewals will, therefore, exceed the net profits by about £2,000.

At a meeting of the City Council on the 4th inst., a report of the Finance Committee relative to the North-Eastern Railway Co.'s Bill, which proposes to run trolley vehicles across the high level bridge, was presented. The recommendation of the committee that the proposals be opposed, as likely to operate against the Council if it should ever desire to obtain control of the passenger traffic of the bridge, was carried. The proposal to promote a Bill in connection with the extension of the tramways to Longbenton and Weetslade was confirmed, Ald. Rodgers stating that the Council had come to an agreement with the Northumberland C.C., whose opposition had been overcome.

**Plymouth.**—The B. of T. has informed the Tramways Committee that, owing to the steep gradients and sharp curves on the system, it could not sanction the proposed introduction of double-deck cars.

The Municipal Tramways Association having informed the Council that it proposes to hold a meeting of the managers' section at Plymouth in the early summer, a sub-Committee has been appointed to make arrangements.

An estimate has been submitted showing that the proposed tramway extension to Lairn would cost, with single track, £6,000, and with double track, £8,300.

The estimates for next year show an anticipated income of £40,000, compared with £38,000 for the past year, and an expenditure of £38,531, compared with £36,626.

**Poole.**—Railless Traction.—The T.C. has decided to withdraw its opposition to the Poole, Sandbanks and Westbourne Railless Traction Bill.

**Prestwich.**—The B. of T. has sanctioned the doubling of a section of the tramway track in Bury Old Road.

**Rochdale.**—A tramcar proceeding down John Street, which has a gradient of 1 in 13, got out of control last Saturday, and dashed into a shop front. The car was wrecked and 18 persons were injured.

**South Shields.**—The T.C. has decided to double the tramway track in Frederick Street, the work to be carried out by the T.C. It also decided to obtain three motor-'buses to run in connection with the tramway system. The Corporation is asking the promoters of the Tyne tube railway to insert a clause ensuring that energy shall be purchased from either North or South Shields Corporation.

**Stirling.**—Proposed Tramways.—At their last meeting the T.C. discussed a report on the electrical and tramway schemes. It was estimated that a complete system of broad-gauge tramway could be constructed at a total cost of £74,000, with a reasonable certainty of success. It was agreed to have the report further supplemented for future consideration.

**Swinton and Pendlebury.**—In response to a request of the Farnworth and Kearsley D.C. and the Clifton P.C., the Tramways and Electricity Committee has decided, subject to a satisfactory service of Salford tramcars being maintained along Station Road, to offer no objection to a tramway to link up the Salford Corporation's and South Lancashire Co.'s systems at Newtown. This will provide another through tramway route between Manchester and Liverpool.

**Tilbury Railway Electrification.**—The Midland Railway authorities have decided to ask Parliament to extend the period from 1914 to 1916, for depositing a scheme for electrifying the Fenchurch Street—Southend route.

**Twickenham.**—The D.C. is to enter into a joint undertaking with the local authorities of Heston and Isleworth, Hampton, Hampton Wick and Teddington not to conclude any agreement with the London United Tramways relative to Clause 5 of the L.U.T. Bill, 1914, to which the marginal note is "agreements as to purchase of tramways by local authority," without first consulting and conferring with each other.

## TELEGRAPH and TELEPHONE NOTES.

**Australia.**—Although only a couple of years have elapsed since the chief electrical engineer of the Postal department (Mr. J. Hesketh) made a tour abroad to acquaint himself with the latest developments in telegraphy and telephony, two more officials are being dispatched on a similar mission. They are Mr. G. H. Morgan, manager of the telephone exchange in Melbourne, and Mr. S. L. Monaghan, assistant manager of the Sydney exchange. They will visit Great Britain, the Continent and the United States, and are expected to be absent from the Commonwealth about six months.—*The Age.*

**Ecuador.**—The cable office and the British Consulate were burned during the recent fighting at Esmeraldas.

**Fire at a Wireless Station.**—On Sunday a fire broke out in the power station of the Post Office wireless station at St. Just (Cornwall) and did considerable damage before it was subdued by the staff. The roof fell in, and the apparatus was put out of operation through the fire. The station is a new one.

**Long-distance Wireless Transmission.**—On Thursday last week the new wireless station at Sayville, Long Island, U.S.A., was in communication with Nauen, near Berlin, a distance of over 4,000 miles. The system used was that of the Telefunken Co.

**New Wireless Receiver.**—Our correspondent in Sweden writes that a Belgian operator, named Brücq, has carried out successful experiments at Fredrikstad, with a simple receiving apparatus of his own invention, which is fixed at the top of a flagstaff, and connected with a telephone. With this apparatus Mr. Brücq has succeeded in receiving signals from the Eiffel Tower, Berlin, and Rundemanden—the station on the west coast of Norway, near Bergen. Between the last-named station and Fredrikstad there is a range of mountains having altitudes up to 2,500 m.

**The Imperial Wireless Contract.**—On Tuesday Lord Murray made a statement in the House of Lords regarding the purchases of shares in the American Marconi Co., for which he was responsible. He said that the facts were known, and there was nothing new to be revealed; he had never been interested in any other wireless shares. He expressed regret that he had not given more consideration to the matter at the time, but said that it was an error of judgment, not of intention.

A motion by Lord Ampthill that a Select Committee be appointed to inquire into the charges which had been made against Lord Murray was postponed until Thursday.

**Switzerland.**—The Federal Budget for 1914 prescribes an expenditure of 9,225,000 fr. for the establishment of new telegraph lines, interurban and international telephone lines, telegraph and telephone cables, &c.

**Wireless in a Lifeboat.**—The new Allan liner *Alsatian* has been provided with a motor-driven lifeboat equipped with an installation of wireless telegraphy, capable of communicating over a distance of 100 miles. One use to which the boat will be put is to scout ahead of the liner in foggy weather, and to report by wireless telegraphy the whereabouts of ice or other dangerous bodies. Two such lifeboats will be placed on board the *Alsatian*, and two on the *Calgarian*, and the Cunard liner *Aquitania* will have four of them.

**Wireless Train Signals.**—Experiments were made last year on the line from Nuremburg to Gräfenberg with an electric system of communication, devised by Christoph Wirth. A vehicle of a train carries receiving antennæ, and the telegraph or telephone lines running alongside the railway serve as sending antennæ. It is possible so to order the arrangements that the working of the telephone or telegraph line is not disturbed. By these means a signal can be transmitted to the engine driver, or the Westinghouse brake can be set in operation.

**Wireless Telegraphy in the German Army.**—The use of wireless telegraphy in the German army has been making steady progress in recent times. Stations are now distinguished as permanent, movable, and airship stations. The permanent stations are established in fortresses; their range is 1,000 km. All fortresses situated on the remotest frontiers are able to communicate with Nauen *via* Berlin and to receive news from distantly located airships.

The movable or field stations are controlled by the officials of commandos, and are either "heavy" or "light" stations. The range of the heavy stations is 200 km., and of the light 60 to 70 km. Heavy stations are posted at the larger headquarters, with army chief commandos and with cavalry divisions.

Light stations are allotted to the cavalry divisions and apportioned to the reconnoitring squadrons, who have charge of the news-gathering arrangements. In this way all news from the officers' of patrols, which streams into the reconnoitring squadron, is quickly passed on through the staff of the Cavalry Division to the heads of the chief commandos and thence to the commander-in-chief.

Dirigible airships are equipped with airship stations, which can, however, only transmit messages. They are not fitted with receivers. Their range is about 300 km. Airships can thus communicate with fortresses and cavalry divisions.

## CONTRACTS OPEN and CLOSED.

### OPEN.

**Aberdare.**—February 28th. U.D.C. Transformer, high and low-tension switchgear and instruments. Supply of cables and feeder pillars.

March 2nd. U.D.C. Service cable; D.C. and A.C. meters; joint boxes, &c. See "Official Notices" February 13th.

**Aberaman.**—March 12th. Electrical goods for a year for the Powell Duffryn Steam Coal Co., Ltd. Stores Manager.

**Ardee.**—March 2nd. Public lighting by electricity for three years, for the Town Commissioners, from September 1st. Particulars from Mr. T. Malone, Town Clerk.

**Australia.**—Sydney (New South Wales).—March 18th. For the Postmaster-General. Seven automatic switchboards. Schedule No. 179. See "Official Notices" February 6th.

Melbourne.—March 5th. 20,000-volt and 1,500-volt underground cables and accessories, for Agent-General for Victoria. See "Official Notices" February 6th.

April 7th. P.M.G. Accumulator batteries (Tudor) for radio-telegraph stations. Relays, non-polarised. Stores Schedule 996. See "Official Notices" to-day.

April 21st. P.M.G. Telephone switchboards. Schedule No. 1,005. See "Official Notices" to-day.

Hobart.—March 2nd. For the Postmaster-General. Telephones, common battery, wall pattern, and table pattern, Schedule T 104. See "Official Notices" January 16th.

Perth.—March 7th. High-tension cables, telephone cable and accessories for the West Australian Government. See "Official Notices" February 13th.

N.S.W.—April 29th. Electrically-controlled clocks for the Post Office, Newcastle, N.S.W. Specification, &c., at office of High Commissioner, 72, Victoria Street, S.W.

**Aylesbury.**—March 7th. U.D.C. Contract 2. Two 100-KW. Diesel oil engine D.C. generating sets, with static balancers, battery boosters and accessories. See "Official Notices" February 13th.

**Barnes.**—March 9th. U.D.C. Distributor cables. See "Official Notices" to-day.

**Barrow-in-Furness.**—Corporation. Converting steam-driven plant at the pumping station to electrical drive. Particulars from Borough Engineer.

**Bosnia.**—Establishment of an electric lighting service. Particulars of the Stadtgemeinde, Gorazda, Bosnia.

**Bedford.**—March 7th. Corporation. Electrically-driven centrifugal pumping plant (four single-phase, 2,000-volt motors, &c.). Specifications, &c., from Major Tulloch & Haworth, 28, Victoria Street, S.W.

**Bedwas.**—March 5th. Electrical goods for a year for the Bedwas Navigation Colliery Co., Ltd. The Secretary.

**Belfast.**—February 23rd. Corporation. Twelve months' supply of stores for Tramways and Electricity Committee. See "Official Notices" January 30th.

**Belgium.**—March 3rd. The municipal authorities of Ghent are inviting tenders for a number of transformers and electrically operated pumps.

March 17th. La Société Nationale des Chemins de fer Vicinaux, of Brussels (14, Rue de la Science) is inviting tenders for the contract for the overhead electrical equipment of the new local electric railway between Ghent and Loochristy.

**Bexley.**—February 25th. U.D.C. 500-KW. turbo-alternator, with exciter, condensing plant and pipe-work, water-tube boiler and superheater, with mechanical stoker. See "Official Notices" February 13th.

**Birkenhead.**—February 24th. Corporation. Continuous-current electricity meters (ordinary and pre-payment). House service fuseboxes. See "Official Notices" February 6th.

**Bolton.**—February 23rd. Corporation. Twelve months' supply of tramway stores. See "Official Notices" February 6th.

February 26th. Corporation. Twelve months' supply of stores for Electricity Committee. See "Official Notices" February 13th.

**Burton-upon-Trent.**—March 14th. Corporation. One 1,250-KW. three-phase turbine-alternator and condenser, pipe-work, valves and accessories. Extensions to high-tension switchboard. See "Official Notices" February 13th.

**Cape Colony.**—March 16th. Water-power plant for Municipality of Paarl, Cape Province (see Electrical Review, page 183, January 30th). Time extended to March 16th. Specifications can be seen in London (C.I. Department, Board of Trade).

**Copenhagen.**—February 21st. Municipality. Three 300-KW. motor generators or converters for sub-stations; also switchgear. See "Official Notices" February 6th.

**Crete.**—March 13th. Tenders for the concession for electric tramways and water supply. See this column in last issue.

**Dublin.**—March 2nd. Corporation. One 210-B.H.P. three-phase E.H.T. motor. See "Official Notices" to-day.

**Edinburgh.**—February 28th. Corporation. Electric lighting installation at the South Gray's Close and Fountainbridge Wash-houses. Specifications from Engineer's Office. Town Clerk.

March 9th. Corporation. Maintaining house telephone and electric bell installations. Forms of tender from Superintendent of Works, City Road.

March 9th. Corporation. Twelve months' supply of electrical and insulating material. Specification from the Resident Electrical Engineer, Dewar Place.

February 20th. School Board. Electric lighting at Castle Hill School. Specifications from Messrs. Crawford & Cumming, consulting engineers, 51, George Street.

**Edmonton.**—February 25th. Electrical lamps for the B. of G. Mr. F. Shelton, Clerk, The Grange, White Hart Lane, Tottenham.

**Eritrea.**—April 15th. The Governor of the Italian Colony of Eritrea, at Asmara, is inviting tenders for the electric lighting of the towns of Asmara and Massua.

**Gateshead.**—February 22nd. Complete wiring of cottage homes, Shotley Bridge (number of lights, about 400). See this column in last issue.

**Gillingham.**—March 6th. Corporation. Twelve months' supply of meters, cables and other stores. See "Official Notices" to-day.

**Gorton (Manchester).**—March 3rd. Great Central Railway Co. Six months' supply of stores. See this column in last issue.

**Heston and Isleworth.**—March 7th. U.D.C. Twelve months' supply of stores, including cables, meters, &c., for the electricity works. See "Official Notices" to-day.

**Hornsey.**—February 24th. Corporation. Electricity meters, cables, cable stores, &c. See "Official Notices" Jan. 30th.

**Ilford.**—February 24th. Corporation. Twelve months' supply of stores for electricity works. See Official Notices" February 13th.

**Leeds.**—February 21st. Corporation. Twelve months' supply of coal and other stores, including a number of electrical items. See "Official Notices" January 23rd.

**London.**—Islington.—February 25th. Natural draught cooling tower and pipework for Electric Lighting Committee. See "Official Notices" January 30th.

February 27th. Electrical fittings and sundries for a year for the B.G. Mr. E. Davey, Clerk, St. John's Road, Upper Holloway, N.

L.C.C. Asylums Committee. March 2nd. Twelve months' supply of electrical sundries; forms of tender from the office of the Asylums Committee, 6, Waterloo Place, Pall Mall, S.W.

St. Pancras.—March 2nd. Corporation. Supply of arc lamp carbons. See "Official Notices" February 6th.

Shoreditch.—March 3rd. Corporation. Extra-high-tension and low-tension switchgear. See "Official Notices" February 6th.

H.M. Office of Works.—February 27th. Three years' supply electric conduit and fittings. See "Official Notices" Feb. 13th.

March 12th. Bellhangers' work to building in the London district during three years. See "Official Notices" to-day.

Battersea.—March 3rd. Corporation. Twelve months' supply of stores for electricity department. See "Official Notices" February 13th.

**Macclesfield.**—March 11th. Electrical goods for one year for the Cheshire County Asylum, Parkside, Macclesfield. Forms from Mr. W. Tingay, Clerk of Asylum.

**Madeira.**—March 31st. General Council of Administration of the District of Funchal, on the Island of Madeira. See this column in last issue.

**Newport (Mon.)**—March 3rd. E.L. fittings for the B.G. Mr. A. H. Rees, Clerk, Queen's Hill.

**New Zealand.**—March 26th. The Dominion Portland Cement Co., Ltd. Hydro-electric plant, Wairua Falls. See "Official Notices" February 13th.

Auckland.—April 21st. The Harbour Board. 1-ton and 2-ton truck cranes. Specifications from London agents, Messrs. W. and A. McArthur & Co., 18, Silk Street, Cripplegate, London, E.C.

**Nuneaton.**—February 21st. Corporation. One 600-kw. high-pressure, geared, direct-current turbo-generator, surface-condensing plant, pipework, &c. See "Official Notices" February 6th.

**Plymouth.**—March 19th. Corporation. Registering punches for use on the Corporation tramways system. Particulars from Town Clerk.

**Ratasek.**—February 28th. Construction of an electric lighting installation. Particulars of the Gemeindeamt, Ratasek, Comitat Tolna.

**Redditch.**—February 24th. Urban District Council. 6,000 tons coal. Stores for the Electricity Department. Main traction switchboard. See "Official Notices" February 6th.

**Rotherham.**—March 12th. Corporation. One 2,000-kw. high-pressure turbo-alternator with condensing plant, switchgear, steam and exhaust piping and accessories; one 1,000-kw. rotary converter, transformer and switchgear; one 20-ton overhead crane. See "Official Notices" to-day.

**Shipley.**—February 24th. U.D.C. Steel girder tram-rails and fishplates for the tramway department.

**Spain.**—March 27th. The Harbour Works authorities at Gijon-Musel are inviting tenders for four electrically-operated cranes and supply mains therefor.

**Swindon.**—March 7th. Corporation. Twelve months' supply of stores for electricity and tramways departments, fuse and service boxes, &c., meters, oils, &c. See "Official Notices" Feb. 18th.

February 25th. Three years' supply of tramway tickets and ticket punches. Specifications from Mr. T. Medcalf, Tramway Manager.

**Tottenham.**—Electrical installation at the central library. Specifications from Mr. W. H. Prescott, engineer to the Council, Council Buildings, The Green.

**Trimdon Grange.**—February 21st. Parish Council. Installation of electric light at Trimdon Grange and Trimdon Colliery villages. Specifications from T. W. Wilkinson, Clerk to the Council, 1, Church View.

**Walthamstow.**—February 25th. Corporation. Stores for electricity supply works and tramways. See "Official Notices" February 6th.

**West Ham.**—March 5th. Guardians. Six months' supply of electrical fittings. Specifications from Mr. T. Smith, Clerk to Guardians, Board Room, Union Road, Leytonstone, N.E.

**Weymouth.**—February 21st. Corporation. 12 months' supply of coal for the electricity works. Specifications from Mr. J. H Bolam, Borough Electrical Engineer, Stavordale Road.

**Wimbledon.** — March 6th. Corporation. Twelve months' supply of stores for electricity department. See "Official Notices" to-day.

**Wolverhampton.**—February 25th. 40,000 tons of partly washed fine and partly unwashed nutty slack coal for the electricity department. Specifications and forms of tender (£1 1s.) obtainable from Mr. S. T. Allen, Borough Electrical Engineer.

**Worle (Somerset).**—March 19th. Street lighting for the Parish Council. Mr. Robert K. Clay, Clerk, Virginia Villa, Worle.

**Wrexham.**—February 28th. Meters, carbon-filament lamps, oils, coal and boiler solution, for the Corporation electricity department. Borough Electrical Engineer, Willow Road.

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## CLOSED.

**Australia.**—N.S.W.—Postmaster-General's Department.

Oil engine and generator at Albury Post Office, £190; switchboard, £110; 336 "Varta" accumulator cells and six Tudor cells, £291.—Falkiner-Boll Electric Co.
250 magneto bells, £112.—James Paton & Co.
200 magneto bells, £260.—Western Electric Co. (Aus.), Ltd.
Telephone material.—Lawrence & Hanson Electric Co., Ltd.—*Tenders.*

**Barnsley.**—The Electricity Committee has accepted the tender of the British Thomson-Houston Co., Ltd., for three electrical motors for the electricity works for £79.

**Basingstoke.**—Messrs. Johnson & Phillips, Ltd., have received an order from the borough authorities for providing, laying and jointing-up complete, a low-tension, three-wire system of mains, paper-insulated lead-covered and steel tape armoured, complete with all feeder pillars, &c.

**Batley.**—The Corporation has accepted tenders as follow:—

Brush Electrical Engineering Co.—One 1,200-kw. turbo-generator.
British Westinghouse Co.—One 500-kw. and one 250-kw. rotary converters.

**Belgium.** — The municipal authorities of Farciennes (Province of Hainaut) last week opened tenders for the electric lighting of the town. For the establishment and equipment of the central station, as a separate contract, the lowest tender was that of the Société des Ateliers de Constructions Electriques, of Charleroi, and for the laying of the necessary network of mains, that of the Société de Gaz et Electricité du Hainaut. As a combined contract, for both the generating station and the mains, the best offer was that of the Société A.E.G. Union Electrique, of Brussels.

**Burnham (Somerset).**—For installing the E.L. in the Town Hall, the U.D.C. received the following tenders:—

| | | |
|---|---|---|
| **Burnham Electric Light Co.** .. .. .. | (accepted) | £40 |
| King & Co. .. .. .. .. .. .. .. .. | | 38 |
| Bellringer & Watts .. .. .. .. .. .. | | 38 |
| Muncey & Pine .. .. .. .. .. .. .. | | 42 |

**Cleckheaton.**—The U.D.C. has accepted the tender of Green's, Ltd., for an economiser for the electricity works.

**Glasgow.**—The T.C.'s Committee on Tramways, Works and Stores recommends the acceptance of the following tenders:—

Cast-iron pipes.—R. M'Laren & Co., Ltd.
Air filter for Pinkston power station.—Heenan & Froude, Ltd.
Ashphalt buckets.—P. & W. MacLellan, Ltd.
Lead-covered cable.—W. T. Henley's Telegraph Works Co., Ltd.

Messrs. Johnston, Park & Co.'s offer for the supply of fittings for the electrician's workshop at the new slaughter house has been accepted.

The Corporation Tramways Department has placed an order with the J. G. Brill Co., for one of their patented radial axle trucks.

**Government Contracts.**—The following tenders have been accepted during the past month by the Government Departments named:—

Admiralty Contract Department.

Electric bells, bell fittings, gongs, &c.—Player & Mitchell, Ltd.; Reid Bros. (Engineers), Ltd.; Chadburns (Ship) Telegraph Co., Ltd.; Sterling Telephone, &c., Co., Ltd.; Spagnoletti, Ltd.; W. McGeoch and Co., Ltd.; Hawkers, Ltd.; D. H. Bonnella & Son, Ltd.

Admiralty Works Department.

Electric generating station, loco. shed, &c., at Crombie.—R. Bruce & Son.

War Office.

350-kw. generator.—J. Howden & Co., Ltd.
Internal wiring for electric lighting Cambridge Hospital, Aldershot.—V. G. Middleton.
Laying cable to and erection of converter at army aircraft factory, Farnborough.—Bruce Peebles, Ltd.

CROWN AGENTS FOR THE COLONIES.

Electrical fittings, &c.—J. Stone & Co., Ltd.
Materials for wireless station.—Marconi's Wireless Telegraph Co., Ltd.

H.M. OFFICE OF WORKS.

Electric cable and wire, Board of Agriculture.—Armorduct Manufacturing Co., Ltd.
Renewal of electric mains, Houses of Parliament.—W. T. Henley's Telegraph Works, Ltd.
Electric wiring, Stationery Office.—Tyler & Freeman.

POST OFFICE.

Protective apparatus.—British L.M. Ericsson Manufacturing Co., Ltd.; International Electric Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L.M. Ericsson Manufacturing Co., Ltd.; Gent & Co., Ltd.; London Electric Wire Co. & Smiths Ltd.; Western Electric Co., Ltd.
Wireless apparatus.—Marconi's Wireless Telegraph Co., Ltd.
Battery boxes.—Standard Woodwork Co., Ltd.
Packing boxes.—C. H. Glover & Co., Ltd,
Telephonic cable.—Callender's Cable Co., Ltd.; W. T. Henley's Co., Ltd.; Johnson & Phillips, Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Desiccators.—Lacy, Hulbert & Co., Ltd.
Stoneware ducts.—Doulton & Co., Ltd.
Ironwork.—Bayliss, Jones & Bayliss, Ltd.; Bullers, Ltd.; F. W. Cotterill, Ltd.; T. W. Louch, Ltd.; J. Sidaway & Co.; Walls, Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; B.I. and H. Cables, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (inc. in London Electric Wire Co. and Smiths, Ltd.).
Copper wire.—B.I. and Helsby Cables, Ltd.
Laying lines of multiple-way ducts, Leeds-Bradford (Section 2).—H. E. Buckley, Manchester, Bury, Burnley. (Section 3).—W. H. Worthington, Ltd. Manchester, Rochdale.—W. Irwin & Co., Ltd.
Laying lines of pipes, multiple-way ducts and "U"-shaped earthenware troughing, Darlington.—M. B. Anderson.
Laying lines of "U"-shaped earthenware troughing and pipes, Reigate.—W. Griffiths & Co., Ltd.
Manufacturing, supplying, drawing-in and jointing lead-covered cable.—Cardiff-Newport (Mon.).—W. T. Henley's Co., Ltd.
Cardiff-Swansea.—W. T. Henley's Co., Ltd.
Liverpool-St. Helens.—B.I. and Helsby Cables, Ltd.
Manchester-Bolton, Manchester-Burnley, Manchester-Rochdale and Newcastle-North Shields.—Siemens Bros. & Co., Ltd.
Telephone exchange equipment, Weybridge.—Peel-Conner Telephone Works, Ltd.

**Huddersfield.**—The Tramways Committee has accepted the following tenders for 10 new cars :—

Dick, Kerr & Co., Ltd.—Electrical equipments.
United Electric Car Co.—Car bodies and trucks, differential gearing to be applied to the cars.

**Italy.**—The Italian State Railway authorities in Rome have lately placed a contract with the Italian branch at Saronno of the Esslingen Maschinenfabrik for the supply of six 84-ton and 12 60-ton electric locomotives, intended to work at a pressure of 3,000-3,300 volts. The contract for the electric equipment of the locomotives has been sublet to the Oerlikon Maschinenfabrik.

**Keighley.**—The Keighley and Bingley Joint Hospital Board has accepted the tender of the Smith Electrical Co., Ltd., for electrical work for the ensuing year.

**London.**—L.C.C.—The Highways Committee recommends the acceptance of the offer of the Brush Electrical Engineering Co., Ltd., for the supply and erection of a traverser at the Abbey Wood car-shed extension, at £437, and of the offer of the British Westinghouse Co., Ltd., for the supply and erection of the electrical equipment for the traverser, at £184. The Committee recommends the acceptance of the tender of Messrs. W. H. Smith and Son for obtaining advertisements on the Council's electric cars, for a period of nine years, on the following basis :—10 per cent. commission on existing orders, and 20 per cent. commission on new contracts, and on the renewal of existing contracts with a guaranteed annual minimum income to the Council, after deducting the firm's commission of 5 per cent. increase on the average revenue, advertisements for the three years ending March 31st, 1914, the firm being allowed to deduct from the amount guaranteed the present cost to the Council of obtaining orders. The net receipts from advertising on cars in 1912-13 were £24,281.

The Highways Committee reports the receipt of the undermentioned tenders for the supply of (I) 500 tons special section rolled-steel bar for type 25A magnets; and (II) 84 tons special section rolled-steel bars for type 26A magnets, required in connection with the maintenance of magnetic brake equipments for the 12 months ending April or May, 1915 :—

| | Price per ton. (I) | (II) |
|---|---|---|
| Lilleshall Co., Ltd. (recommended) | £6 10 0 | £6 10 0 |
| Andrew Brown & Co. (agent for Société Anonyme des Acieries d'Angleur, Belgium) | 7 1 6 | 7 1 6 |
| Frodingham Iron and Steel Co., Ltd. | 6 14 9 | 6 14 9 |
| John Batt & Co. (London), Ltd. | 7 0 0 | 7 0 0 |
| Cargo Fleet Iron Co., Ltd. | 6 16 6 | 6 16 6 |
| Geo. Schultz & Co., Ltd. | 7 2 6 | 7 2 6 |
| Earl of Dudley Round Oak Works, Ltd. | 7 2 6 | 7 15 0 |
| P. & W. McLellan, Ltd. | 7 2 6 | 7 15 0 |
| Henry Bessemer & Co., Ltd. | 8 0 0 | 8 0 0 |
| W. Bain & Co., Ltd. | 9 0 0 | 9 10 0 |
| Robt. Murdoch & Co. | 9 5 0 | 9 5 0 |
| D. Colville & Sons, Ltd. | 9 5 0 | 9 5 0 |
| Brown & Tawse | 9 12 6 | 9 12 6 |
| " " (alternative) | 8 7 6 | 8 7 6 |

The Main Drainage Committee reports the receipt of the following tenders for wiring and fitting for the electric lighting of the new building in connection with the enlargement of Crossness pumping station :—

| | |
|---|---|
| A. Hawkins & Son (recommended) | £559 |
| Foote & Milne, Ltd. | 574 |
| R. H. & J. Pearson, Ltd. | 575 |
| H. J. Cash & Co., Ltd. | 648 |
| Tredegar & Co. | 716 |

STEPNEY.—The Electricity Committee recommends the acceptance of the offer of the Shipping and Coal Co., Ltd., of a barge of about 140 tons of 1½-in. York slack, at 13s. 11d. per ton, for trial purposes.

KENSINGTON.—The Guardians have received the following tenders for a supply of electric lamps and fittings :—

| | £100 |
|---|---|
| Pryke & Palmer (accepted) | |
| Brompton and Kensington Electric Supply Co., Ltd. (irregular) | 76 |
| British Economical Lamp Co., Ltd. (four items only) | 80 |
| "Z" Electric Lamp Mfg. Co., Ltd. (four items only) | 79 |
| Maxim Lamp Works, Ltd. (four items only) | 68 |
| Cryselco, Ltd. (four items only) | 62 |
| London Electric Warehouse Co. (four items only) | 59 |
| Cooper & Roberts (five items only) | 81 |
| Brimsdown Lamp Works, Ltd. (five items only) | 67 |
| General Electric Co., Ltd. (11 items only) | 97 |
| Siemens Bros. Dynamo Works, Ltd. (10 items only) | 88 |
| Edison & Swan Co. (10 items only) | 87 |
| British Westinghouse Co. (seven items only) | 77 |
| Baxter & Caunter, Ltd. (eight items only) | 79 |
| Atlas Electrical Co., Ltd. (10 items only) | 72 |
| Pope's Electric Lamp Co., Ltd. (six items only) | 61 |
| Kanson & Co., Ltd. (six items only) | 49 |

**Luton.**—The T.C. has accepted the tender of the Atlas Engineering Co., Ltd., at £168, for a lathe for the electricity works.

**Nelson.**—A syndicate responsible for the scheme of erecting arcades and shops at Nelson has accepted a tender from Messrs. Carter & Sons, for electric lighting installations.

**Newport (Mon.).**—In view of the very favourable condition of the copper market, the borough electrical engineer has purchased, through Messrs. Callender's Co., 15 tons of copper for making into cables, at £65 per ton.

**New Zealand.**—The Gisborne Hospital Board has accepted the tender of Messrs. Holford & Co., at £1,398, for electric lighting and power plant for the new hospital.—*New Zealand Shipping and Commerce.*

**Stalybridge.**—The T.C. has accepted the tender of Mr. H. Gordon, Ashton, for an electric light installation in connection with the extensions of the milk sterilisation depôt.

**Weymouth.**—The T.C. has accepted the tender of Mr. J. H. Rankin, for electrical wiring work at 4, Portland Buildings.

**Whitstable.**—The contract for the whole of the plant and mains for public electric lighting supply has been placed with Messrs. J. B. Saunders & Co., Ltd., of Westminster, the work being carried out under the supervision and to the specification of Mr. H. R. J. Burstall, of Messrs. Burstall & Monkhouse.

## THE ELECTRICAL ENGINEERS
### (LONDON DIVISION).

Commanding Officer—LIEUT.-COL. H. M. LEAF.

The following orders have been issued for the current week :—

Monday, February 23rd.—"A" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Tuesday, February 24th.—"B" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Wednesday, February 25th.—Recruits only. Infantry drill, 7 to 8 p.m. Technical instruction, 8 to 10 p.m. Rating examination for all Companies, 7 to 10 p.m.

Thursday, February 26th.—"C" Company. Technical instruction, 7 to 10 p.m. Miniature range instruction, 7 to 9 p.m.

Friday, February 27th.—"D" Company. Technical instruction, 7 to 10 p.m. Miniature range instruction, 7 to 9 p.m.

Saturday, February 28th.—Headquarters will be opened for regimental business from 10 a.m. till 12 noon.

(Signed) F. R. HOLT-WHITE, Capt. R.E., Adjutant.
For Officer commanding L.E.E.

**Bijur Motor-car Lighting and Starting Equipment Tests.**—We have received from Messrs. Duncan Watson and Co., of Berners Street, W., some interesting test figures relating to the Bijur car lighting and starting equipment, for which they hold the sole selling and manufacturing rights in this country. The tests were carried out by the Automobile Club of America, under severe conditions, and show with a 38-H.P. six-cylinder engine, that, at 20 miles per hour, the cost would be $7.88 per year for lighting and cranking, and at 40 miles per hour would be $6.38 per year, measured in petrol consumed. The tests were made with all the lights on all the time, and the figures are based on 10,000 miles of service within the year. The generator was giving out between 17 and 18 amperes continuously, and, in the opinion of the Packard Motor-car Co., which has adopted this apparatus in the States, the test conditions were from five to ten times as severe as ordinary working conditions; the cost for the latter would therefore average between 71 c. and $1.42 per year or per 10,000 miles of driving, which represents a negligible item, in view of the fact that some more costly form of lighting would have to be installed if electric lighting were not used. In one official test the engine was run from the battery for 25 minutes at a speed of 135 R.P.M.

## FORTHCOMING EVENTS.

**Institution of Mechanical Engineers.**—Friday, February 20th. At 8 p.m. At Storey's Gate, S.W. Paper on "Some Modern Methods of Welding," by Mr. T. T. Heaton.

**Electrical Engineers' Ball.**—Friday, February 20th. At Hotel Cecil.

**Greenock Electrical Society.**—Friday, February 20th. At 7.45 p.m. At Temperance Institute, West Stewart Street. Paper on "Power Station Design," by Mr. J. Punch.

**Manchester Electro-Harmonic Society.**—Friday, February 20th. At Albion Hotel. Concert.

**Wolverhampton and District Engineering Society.**—Friday, February 20th. At 7.45. At Technical School. Presidential address ("Electricity and Gas") by Mr. C. E. C. Shawfield; "The Cooking Problem—Why Electricity is Winning," by Mr. F. S. Grogan.

**Royal Institution of Great Britain.**—Saturday, February 21st. At 3 p.m. At Albemarle Street, W. Lecture (II) on "The Electric Emissivity of Matter," by Dr. J. A. Harker.

**University College, Nottingham.**—Saturday, February 21st. At 3 p.m. Educational and Scientific Exhibition to be opened by Lady Henry Bentinck.

**Institution of Civil Engineers.**—Tuesday, February 24th. At 8 p.m. At Great George Street, S.W. Papers on "Rail-Steels for Electric Railways," by Mr. W. Willox, and "Rail-Corrugation and its Causes," by Mr. S. P. W. D'A. Sellon.

**Nottingham Society of Engineers.**—Wednesday, February 25th. At "Welbeck" Hotel, Milton Street. Paper on "Ventilating and Heating," by Mr. W. Townsend.

**Royal Society of Arts.**—Wednesday, February 25th. At 8 p.m. At John Street, Adelphi. Ordinary Meeting.

**Institution of Electrical Engineers.**—Thursday, February 26th. At 8 p.m. At Victoria Embankment. Paper on "Motor and Control Equipments for Electric Locomotives," by Mr. F. Lydall.

**(Newcastle Local Section).**—Friday, February 20th. At 7 p.m. At Hugh Bell School, Middlesbrough. Discussion on "Coal and its use in Steam Raising," introduced by Mr. P. S. Thompson.

Monday, February 23rd. At 7.30 p.m. At Armstrong College of Science. Paper on "Some Railway Conditions Governing Electrification," by Mr. R. T. Smith.

**(Yorkshire Local Section).**—Friday, February 20th. At 6.30. At Hotel Metropole, King Street, Leeds. Annual Dinner.

**(Manchester Local Section).**—Tuesday, February 24th. At 7.30 p.m. At University (Physical Laboratory). Paper on "Some Railway Conditions Governing Electrification," by Mr. R. T. Smith.

**Institute of Marine Engineers.**—Thursday, February 26th. At 7 p.m. At Liverpool Street Hotel. Annual meeting.

**Junior Institution of Engineers.**—Friday, February 27th. At 8 p.m. At 39, Victoria Street. Paper on "Operation and Upkeep of Electric Motors," by Mr. B. F. Butler. Saturday, February 28th. At 6.30 p.m. At Holborn Restaurant. Annual dinner.

Saturday, February 21st. At 8 p.m. At Cutlers' Hall, Sheffield. Inauguration of Local Section.

**Northampton Engineering College Engineering Society.**—Friday, February 27th. At St. John Street, E.C. Paper on "The Forth Bridge," by Mr. H. J. Nichols.

**North-East Coast Institution of Engineers and Shipbuilders.**—Friday, February 27th. At 7.30 p.m. At Bolbec Hall, Newcastle-upon-Tyne. General meeting.

**Physical Society.**—Friday, February 27th. At 8.30 p.m. At Imperial College of Science, South Kensington. Guthrie Lecture, by Prof. R. W. Wood, on "Radiation of Gas Molecules Excited by Light."

**Royal Institution of Great Britain.**—Friday, February 27th. At 9 p.m. At Albemarle Street, W. Paper on "Surface Combustion," by Prof. W. A. Bone, F.R.S.

**Manchester Association of Engineers.**—Saturday, February 28th. At Grand Hotel, Aytoun Street. Paper on "Mechanical Filtration," by Mr. A. J. Clark.

**Batti-Wallahs' Society.**—Saturday, February 28th. Annual Dinner.

## NOTES.

**Annual Dinners.**—The India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd. (the Silvertown company), held their thirty-first annual dinner and social evening on Saturday last, at the Liverpool Street Hotel, E.C. A record number of 152 was present, and a most enjoyable evening was spent. Mr. A. P. Crouch (secretary) was in the chair, and Mr. F. C. Crawford (submarine department) in the vice-chair. The toast, "Success to the Company, its Agents, and the Annual Dinner," was proposed by Mr. Crouch in a very interesting speech, and responded to on behalf of the company's agents by Mr. W. J. Head, of the Newcastle branch. Mr. S. A. Russell (works manager) proposed "The Chairman," and Mr. C. H. Hills (general stores department), "The Vice-Chairman." The musical programme was in the able hands of Mr. T. W. Reeds, who engaged the following artistes:—Miss Elizabeth Hyde, Miss Hope Jackson, Miss Doris Lee, Miss Nellie Perryer, Mr. Alfred C. Steed, Mr. Owen Way, Mr. Harry Knight, Mr. Jock MacCallum, and Mr. Eustace Wallace (accompanist). The following acted as Committee:—Messrs. W. Best (chairman), W. Blair, A. Cheetham, C. H. Hills, T. Lockwood, F. Matthews and T. W. Reeds.

The employés of the Blackpool, St. Anne's and Lytham Tramways, to the number of nearly 100, assembled at Collinson's Café, South Shore, Blackpool, on Wednesday evening, February 11th, on the occasion of the annual dinner. Mr. Laing, the manager, presided.

**Electrical Congress in Russia.**—Arrangements are in hand for the holding during the coming summer of an All-Russian Electrotechnical Congress at Kharkov during the coming summer, with the view of developing the use of electrical installations in connection with the mining undertakings in the Donetz district.

**"F" Rays.**—It is reported from Florence that the Italian Government has carried out experiments with the system invented by Signor Ulivi for exploding submerged torpedoes, and has secured the right to use it.

**International Electrotechnical Commission.**—The report on "International Symbols" has just been issued by the I.E.C. (publication No. 27; to be obtained from the general secretary, Mr. C. le Maistre, 28, Victoria Street, S.W., price 2s. 1d. post free); it was unanimously adopted at the Berlin meeting of the Commission, and consists of certain rules of principle, together with a list of 36 symbols that have been officially adopted. A number of signs for the names of units and a few mathematical rules and symbols commonly employed by electricians are included. The International Electrical Congress at San Francisco next year will be asked to adopt the term "Siemens" for the unit of conductance. It is hoped that the symbols recommended by the I.E.C. will be widely adopted by lecturers, authors and others concerned with the study of electrotechnics. To a considerable extent the symbols correspond with those in current use. Fundamental requirements are that they must be distinguishable from one another when written on paper or on a blackboard, and that it must be possible to spell them out whilst writing them; the distinction between roman letters and italics, therefore, is abandoned, and small roundhand letters, as well as Gothic type, cannot be used. Suggestions are made in the report as to the course to be followed where the symbols habitually used by physicists and mechanical engineers occur in conjunction with the electrical symbols. The symbols recommended differ from those to which English readers are accustomed in very few cases. There are, however, some curious features in the lists. For instance, work and energy are allotted separate symbols; after numerical values capital letters, the initials of the names of the respective electrical units, are employed, but where these are combined with other letters, small type is used, so that, for instance, we get kWh. for kilowatt-hour. The symbol $\omega$ for ohms is abolished, as well as $\Omega$ for megohms, but substitutes have not yet been definitely adopted; O or $\Omega$ is provisionally recommended for ohms The use of the comma or the full stop for separating decimals from whole numbers is left to follow the custom of the country, and an attempt is made to avoid confusion by substituting a space for either of them in writing whole numbers of four or more digits—thus, one million is 1 000 000. As the report is copyright, readers who desire to make themselves acquainted with its details must obtain copies of it from headquarters.

**Fatalities.**—A correspondent states that George Gray, Stirling, was electrically killed while working in Polmaise Colliery on the night of February 10th. He had just finished his shift, and while in the act of putting his lamp away, touched a "live" wire, and was killed instantaneously.

An inquiry was held on 10th inst. into a fatality which occurred on 4th inst. at Littleburn Colliery, Co. Durham. The victim was Joseph Edward Blackburn, 49, a fitter's assistant. It was stated in evidence that on 4th inst. Blackburn was engaged in opening a steam valve 14 ft. from the ground. He was seen standing on some metal pipes against the side of the engine house, but later was found on the ground unconscious. A witness named Owers said that there were some wires which passed from three insulators at an angle of 45° across the pipes, and Blackburn would have to stoop down to get to the steam pipes. Another fitter named Jones expressed the opinion that Blackburn, having finished his work, in straightening himself up had come into contact with the wires, which were unprotected. The pressure was 445 volts, alternating current. Dr. Hare gave it as his opinion that death was due to concussion or shock; most probably the man had been electrically shocked. A verdict that death was due to the deceased having come into contact with the wires was returned.

An inquest was held at Manchester, on 9th inst., into the cause of death of a man named Clarke, aged 50. A tramcar collided with a horse and lorry in Queen's Road on 4th inst. There were in all 16 witnesses, and the evidence was very conflicting. The car driver said that he applied his electric brake about 10 yards away. The deceased man was riding on the lorry when the car came up from behind. The jury returned a verdict of "Accidental death," adding that they thought the tramcar driver did not show sufficient care.

**The Birthday of the Bioscope.**—Exactly 18 years ago to-day Mr. R. W. Paul exhibited for the first time his "Theatrograph," at a conversazione of the students of the City and Guilds of London Technical College, Finsbury. A short description of the apparatus, with an illustration, appeared in our issue of February 21st, 1896. In its original form it was designed for operation in conjunction with a projection lantern, using the films of the kinetoscope, which Mr. Paul had been manufacturing during the previous two years, and of which it was the logical outcome. The machine was driven by hand, but the cycle of operations followed was essentially the same as that employed in the modern kinematograph. Moving pictures of the sea and of the interior of a workshop were shown, and a few weeks later hand-coloured films were exhibited. The extraordinary development which has ensued is familiar to all town-dwellers. Not only is the "Electric Theatre" one of the most popular places of entertainment, and a source of revenue not to be despised by the supply authorities, but also the moving picture has been applied to educational purposes with the greatest success, and its influence in various directions is far-reaching.

**Football.**—A football match was recently played between the representatives of the Newcastle-on-Tyne branch of the General Electric Co., Ltd., and Messrs. Robson & Coleman, contractors, of the same city, with the following result:—General Electric Co., 2 goals; Robson & Coleman, 1 goal.

**Institution and Lecture Notes.**—The Concrete Institute.—On February 12th a discussion took place on a paper on "Factory Construction," by Mr. Percival H. Fraser, A.R.I.B.A. The next meeting of the Institute will take place on February 26th, 1914, when Mr. W. Cyril Cocking will read a paper entitled "Calculations and Details for Steel Frame Buildings from the Draughtsman's Standpoint."

The Physical Society.—At the annual meeting of the Physical Society on Friday last, Prof. Sir J. J. Thomson was elected president. It was announced that owing to the improved financial condition of the Society its activity was to be increased. It had been decided to issue from to time reports on subjects of general interest. The Council had also decided to arrange for the delivery of an annual or occasional lecture by some eminent physicist, and the first of the lectures would be delivered by Prof. R. W. Wood (see "Forthcoming Events").

Institution of Electrical Engineers.—At the meeting of the Birmingham Local Section on Wednesday last, Mr. Roger T. Smith read his paper on "Some Railway Conditions Governing Electrification." The discussion was closed.

Royal Institution.—In the course of his first lecture on "The Electric Emissivity of Matter," Dr. J. A Harker said that he had been able to bring about the emission of electrons by heating substances in a cooled cylinder of carbon without the use of an electric current.

Institute of Metals.—This Institute holds its annual meeting on March 17th and 18th, at the Institution of Mechanical Engineers, in London. A programme of papers and other arrangements has been issued.

**Getting Rope over Top of Stack.**—Several times within his experience the writer has had to place a rope over the top of a self-supporting stack. Sometimes it has been desirable to paint the outside of the smokestack, and the rope running through the pulley at the top has broken or fallen. Frequently in isolated plants inconvenience is occasioned by this trivial accident.

There are several simple methods for getting a wire or a rope over the top of the stack. One method is to use an ordinary skyrocket with a cord attached, on the inside of the stack. By shooting the rocket up the stack the stick will fall on the outside, and pull a fine cord with it, which will in turn pull a larger one up until a rope of any size desired can be drawn up. It is an easy matter then for anyone to scale a stack with a rope that is extended up the inside, and down to the ground on the outside.

Sometimes in isolated places a skyrocket is hard to obtain at some seasons of the year, and then a much simpler method can be employed. It consists of erecting a cross-bow inside the stack and then shooting an arrow, or any other projectile, up the inside and letting it fall on the outside, pulling a fine cord with it. In some of the larger cities, where steeple-jacks can be secured, this work can be delegated to them, but it will save much expense if the engineer in charge knows this little trick of getting the rope over the top of the stack.—Letson Balliet in *Power*.

**Legal.**—We have received the following letter from the solicitors to the plaintiffs in the case reported on page 278 of our last issue :—

"In your issue of Friday last, the 13th inst., you reported the hearing of an action brought by our clients, the Morgan Crucible Co., Ltd., against the Electrical Engineering and Equipment Co., Ltd., heard as a short cause in default of appearance before Mr. Justice Eve on Wednesday, the 10th inst., and that his Lordship had granted an injunction restraining the defendants from infringing our clients' letters patent.

"Owing to a technical irregularity in the proceedings, we are applying to the Court to rescind this order, and the action will therefore be continued and heard in due course.

"We shall feel obliged if you will kindly insert this correction in the next issue of your paper.

"Johnson, Weatherall & Sturt.

"7, King's Bench Walk, E.C., *February 18th*."

**Copper.**—After the large increase during December, visible supplies are inclined to diminish again. Messrs. Merton's statistical circular for mid-February shows that, during the fortnight completed on the 14th, English stocks lost 321 tons, while the French acquired 161 tons. European visible supplies only lessened by 122 tons, to 25,822 tons.

Supplies from America are above average. From Spain and Portugal the quantity is low to England and France, though up to the average elsewhere. Chile shipments are over the average, and Australian considerably so (supposing the figure to be doubled for the month). Total deliveries implies a normal figure, if the same rate be maintained.

American stocks at the end of January showed a falling-off of 1,850 tons, after their large rise in December. The world's visible supply stood, on January 31st, at 64,915 tons, a higher figure than has been given since last May, with the exception of that for December.

**Magnetic Miracles.**—A "miracle-worker" in France has been prosecuted by the local medical society for the illegal practice of medicine. His method was to make mystic passes over empty bottles brought by his clients; he then said the bottles were "magnetised," and instructed the patients to fill them with water and drink a glass before each meal. Marvellous results are said to have followed the treatment. The amusing part of the incident lies in the fact that the wizard was acquitted by the court on the ground that magnetism is not yet a recognised science.

**Improved Efficiency of Tungsten Lamps.**—During the last few months the specific consumption of tungsten lamps has been considerably reduced, this increase in efficiency having been brought about by gradual refinement of the methods of construction and the materials which enter into the manufacture of the lamps. Perhaps the most noteworthy of these changes is that for the 110-volt lamps in sizes larger than 100 watts. The specific consumption of these units has been reduced to 0·90 watt per candle, directly increasing the candle-power over 11 per cent. The 20-watt, 110-volt lamp has been similarly improved from 1·25 watts to 1·17 watts per candle, while the new 40-watt lamp has a specific consumption of 1·10 watts per candle. "Half-watt" street series lamps, having an actual specific consumption of 0·7 watt per candle, are now regularly available in 80, 200, 350, 600 and 1,000-watt sizes for both 6·6-amp. and 7·5-amp. circuits. For 110-volt multiple operation there are offered both a 750-watt lamp of the above efficiency and a 1,000-watt lamp which operates at 0·65 watt per candle.—*Electrical World*.

**The Conductivity of Locomotive Funnel Gases.**—In a note communicated to the Société Internationale des Electriciens, Mr. Parodi recently referred to the difficulty of maintaining the insulation of high-pressure lines in tunnels traversed by steam locomotives, which could not be explained by the deposit of carbon on the insulators, for this was found to have little effect on their efficiency. He attributed the loss of insulation to the ionisation of the gases and vapours emitted by the funnels, according to the Armstrong phenomenon; he had verified the fact by experiment, and had also observed the vibrations of the smoke in the neighbourhood of wires at high pressure. It seemed possible that ionisation of the atmosphere might also be the cause of the difficulties met with in insulating high-pressure lines in tunnels not traversed by steam locomotives, but ill-ventilated, and that the damp surroundings alone did not afford an adequate explanation.

**The Electro-Harmonic Society.**—The concert held on Monday last at the King's Hall, Holborn Restaurant, was a Ladies' Night in more senses than one, for the lady artistes triumphantly carried off the honours of the evening. Miss Violet Oppenshaw and Miss Annie Bartle delighted the audience with their charming rendering of charming songs, and Miss Olive Twain's amusing "Humoresques" with Cyril were appreciated. Mr. Ernest Hastings, an old friend, plaintively lamented the flying years, and Senhor Gomez performed delightful selections on the violin; but the ladies made the concert a success. The Hall was full, as usual.

**Our Railway Directors.**—A morning paper has analysed the constitution of the boards of 28 leading railways in the British Isles, and it finds that the following are among the directors :—2 Dukes, 4 Marquises, 6 Earls, 8 Viscounts, 26 Lords (including courtesy titles), 27 Baronets, 19 Knights, 13 Honourables, 8 Colonels, 3 K.C.'s, 1 Admiral, 1 Judge, 1 Major. It may be that in some degree this may be regarded as an interesting commentary on Lord Claud Hamilton's statement as chairman of the Great Eastern.

**Electrically Sterilised Milk.**—The Liverpool Corporation, says the *Manchester Courier*, is now sterilising by electricity the whole of the infants' milk supplied to the public from the various Corporation milk depôts in that city. All tubercular and manurial contamination is said to be completely annihilated, and any danger from zymotic disease infection thereby prevented. The taste and constitution of the milk remain unaltered by this form of sterilisation.

**Mr. John Burns at Diesel Engine Works.**—Before speaking at Stockport on Saturday evening last, the Right Hon. John Burns, M.P., President of the Board of Trade, visited the Diesel oil engine works of Messrs. Mirrlees, Bickerton & Day. Among those present at luncheon provided by the firm were Mr. Spencer Leigh Hughes, M.P., Messrs. Colin, Charles, and H. T. Day, Mr. H. N. Bickerton, Mr. H. S. Russell, Mr. C. E. Windeler, and Mr. R. Onions.

**"The Electric House" at Southend.**—At the Exhibition of Industries which is being held at the Kursaal, Southend-on-Sea, from February 11th to 25th, the Electric Supply Publicity Committee has its "Electric House" exhibit. A special booklet has been issued for distribution in connection with the occasion, as in the case of the Olympia and Birmingham displays.

**Radium in Demand.**—At a meeting in Manchester on Friday last, it was decided to establish a central fund for the whole of the hospitals, for the purchase of radium. Ashton and Sheffield are also raising funds for this purpose.

**Appointments Vacant.**—Supernumerary switchboard attendant (36s. 2d.) and electrical tester (45s.), for H.M. Dockyard, Devonport; electrician attendant, for County Asylum, Rainhill, near Liverpool; chief assistant in the Physics and Electrotechnics Department, Borough Polytechnic Institute (£180); mains superintendent for Darlington Corporation Tramways Department (£200). Particulars are given in our advertisement pages.

**The A.E.S.E.**—The head office of the Association of Electrical Station Engineers is to-day being transferred from Stratford, E., to 41, Warren Road, Leyton, London, N.E.

**Employers and the Trade Disputes Act.**—At a meeting of the Employers' Parliamentary Council, held at 25, Victoria Street, Westminster, on February 4th, to consider the grave industrial situation due to the Trade Disputes Act and to the unchecked conspiracy of labour Unionism against private freedom and public welfare, arrangements were made to hold a mass meeting of representatives of the Associations of Employers connected with the various industries in the United Kingdom to urge upon the Government the need for an inquiry into the working and the effects of the Act, to determine whether the present unlimited area in which picketing in unlimited numbers may be carried on should not be restricted and the number of pickets regulated by Statute, whether combinations for disorganising trading and social conditions should not be made unlawful, and whether it is not of national interest that all Unions should be subjected to the ordinary law of the land, and made responsible, like all other classes, for their actions.

**Educational Note.**—Imperial College of Science, City and Guilds (Engineering) College, South Kensington, S.W.—A course of instruction in Electro-Magnetic Machinery, including The Design, Manufacture and Testing of Transformers, will be given by Mr. F. E. Berry, commencing March 5th. Particulars are given in our advertisement pages to-day.

## OUR PERSONAL COLUMN.

*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*

**Central Station Officials.**—The Ipswich T.C. has granted a bonus of £100 for the year ending March 31st, 1914, and a similar bonus for the following year, to Mr. F. Ayton, engineer and manager of the electricity works and tramways. The last increase of Mr. Ayton's salary was confirmed in May, 1910, he undertaking to remain in the Council's service for five years from that date.

The Stepney B.C. is recommended to make the following increases in salaries of its employés on the clerical staff of the electricity department:—Mr. A. J. Squire, chief clerk, on his appointment as deputy commercial manager, from £270 to £300 per annum, and subsequently by annual increments of £25 to £350. Class I. Mr. E. E. Dorking and Mr. E. E. Pepper, from £180 to £190 per annum, rising by annual increments of £10 to £200. Class H. Mr. E. W. Simmons, from £150 to £160 per annum, and by annual increments of £10 to £180; Mr. A. M. Apps, from £130 to £150 per annum, and by annual increments of £10 to £180. All the above increases to date from April 1st, 1913. Class F. Mr. C. Taylor, from £70 to £100 per annum, and by annual increments of £10 to £130, to date from April 1st, 1914.

At the Sheffield City Council meeting last week there was a discussion on the recommendation of the Electric Supply Committee that the salary of Mr. S. E. Fedden, general manager of the electric supply undertaking, be advanced from £800 to £900, and then by annual increments of £25 to £1,000. Mr. Harold Jackson moved that the question be deferred until the special committee appointed to inquire into the commercial management of the undertaking had reported. After an hour's discussion, the amendment was defeated by 33 votes to 21. The advance of £100 was agreed to, the matter of the further increments being deferred until the report referred to was considered. Alderman Hobson, the chairman of the special committee, explained how the committee had been delayed in its work by litigation and by the Corporation Bill of 1912. It was perfectly clear that the committee could not deal with the question of the separation of the position of commercial manager and engineer until they had arrived at a conclusion as to what the scope of the commerce was to be in the future. He could only promise he would push on with that question as rapidly as he could, and would report at the earliest possible moment.

After several divisions, the Electricity Committee of Glasgow T.C. recommends the following minima and maxima salaries for higher officials in the department:—Chief engineer, £1,000 and £1,250 respectively; chief assistant, £500 and £700; chief clerk and accountant, £300 and £500; superintendent of mains, £300 and £500; constructional engineer, £250 and £400; treasurer's chief assistant, £200 and £300; chief book-keeper, £200 and £300; two chief surveyors, £200 and £300.

Mr. E. Fenton, who has left the Warrington electricity works for Yorkshire, was recently presented by Mr. F. V. L. Mathias (borough electrical engineer) with a rose-bowl. Mr. Mathias expressed regret at losing a capable assistant.

Mr. A. E. Collings, has been appointed sub-station assistant to the Stoke Newington undertaking at 30s. a week, in place of Mr. R. F. Rampe, resigned.

At the electricity works, Worksop, on 11th inst., Mr. Harold Hall, the station superintendent, who has obtained an appointment at the Dewsbury Electricity Works, was the recipient of a pipe, and a pair of military hair brushes, subscribed for by the staff of the electrical department. The presentation was made by Mr. J. Percival Crowther, manager and engineer.

Mr. C. N. Hefford, manager of the Leeds Corporation electricity department, has been presented by power consumers with a large silver candelabrum in appreciation of his efforts in maintaining an efficient service during the recent strike of municipal workers.

The Salaries Committee of Newport (Mon.) Corporation has decided to make the undermentioned increases in the salaries of the following officials employed in the electricity and tramway departments:—Mr. A. B. Adams, assistant mains superintendent, £119 12s. to £125 12s.; Mr. A. H. Felton, station superintendent, £143 to £156; Mr. W. J. Willis, deputy ditto, £143 to £150; Mr. H. C. Sanders, senior engineer-in-charge, £130 to £143; Mr. W. H. Clark, ditto, £114 8s. to £119 12s., and by annual increments of £6 to £130; Mr. F. Debley, junior ditto, £91 to £104; Mr. G. Ingham, ditto, £78 to £91.

**Tramway Officials.**—Mr. H. Holliday, engineer and manager to the Torquay Tramways Co., has accepted the position of engineer and manager to the Rhondda Tramways Co., of Porth (Glam.), and will leave Torquay early in May.

**General.**—The annual general meeting of the Optical Society was announced to be held on February 12th, but as a mark of respect to the memory of the late Sir David Gill, K.C.B., F.R.S., who was president of the Society at the time of his death, the proceedings were adjourned after a suitable resolution had been passed putting on record the appreciation of his very great services to the Society and to science generally; and to express the deep sympathy of the Society with Lady Gill.

At the annual dinner of the Aberdeen P.O. Electric Golf Club, the Postmaster presented prizes to the following successful members:—Messrs. D. Dawson, A. C. Duthie, C. Eaton, J. Gordon, S. I. Rae, J. Reid, J. Ross, A. Smart, J. M. Smith, R. Thomson, D. F. Webster, P. Wood and W. G. Wright.

The appointment has been confirmed of Mr. D. J. Barnes as district telephone manager at Blackburn. Mr. Barnes, who has been in the service 27 years, has held positions at Manchester, Rochdale, Plymouth, Birmingham, Brighton and Bradford.

Mr. T. Rowland Wollaston has resigned the position that he has held during the last seven years as North-Western representative of the Power-Gas Corporation, Ltd., of Stockton-on-Tees. He will continue his consulting practice at Lord's Chambers, 26, Corporation Street, Manchester.

Mr. W. M. Selvey, Wh.Sc., M.I.E.E., who for the past 10 years has been associated with Messrs. Merz & McLellan, and the power companies of Tyneside, and latterly with the Wallsend laboratories, has now set up in business on his own account as a consulting engineer. His address is Independent Buildings, Sheffield.

Mr. S. M. Hills has resigned his position as a representative for Messrs. Ferranti, Ltd., to take up an appointment as assistant sales manager in London to the Record Electrical Co., Ltd., Caxton House, Westminster, S.W.

Mr. Bernard Dees, a member of the staff at the works of Messrs. Crompton & Co., Chelmsford, is leaving for Cuba, and has been presented with a case of pipes as a farewell gift.

Mr. Harry A. Blackburn, only son of Mr. A. A. Blackburn, chief engineer, Belfast city tramways, who has just completed his apprenticeship with Messrs. Workman, Clark, Ltd., Belfast, has now joined the British Westinghouse Electric and Manufacturing Co., Ltd., of Trafford Park.

It is announced in the *Times* that Dr. E. E. Fournier d'Albe, Assistant Lecturer in Physics at the University of Birmingham, has been appointed Special Lecturer in Physics at the University of the Punjab, Lahore.

## NEW COMPANIES REGISTERED.

**Universal Economisers, Ltd.** (133,836).—This company was registered on February 7th, with a capital of £20 in 1s. shares, to acquire inventions relating to heating, lighting, fuel economisers, heat regulators, &c. The subscribers (with one share each) are:—F. G. H. Hull, 16, Hermitage Road, Finsbury Park, N., clerk; R. W. Pollard, 26, Tasman Road, Stockwell, S.W., clerk. Private company. The number of directors is not to be less than two or more than five: the first are P. Hennessy, Paris; N. G. Gwynne, Red House, Broxbourne, Herts.; and C. F. Mendl, Paris. Registered office, 17, Farringdon Street, E.C.

**Gresham Export Co., Ltd.** (133,728).—This company was registered on February 3rd, with a capital of £500 in £1 shares, to carry on the business of electrical, mechanical or chemical engineers, electricians, manufacturers, exporters and importers of electric lamps, generators and accumulators, &c. The subscribers (with one share each) are:—T. Durrant, 34-6, Gresham Street, E.C., merchant; A. Wright, 34 6, Gresham Street, E.C., accountant; W. F. Mohr, 1, Guildhall Chambers, E.C., merchant. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. Registered by Ashurst Morris Crisp & Co., 17, Throgmorton Avenue, E.C.

**South Wales Transport Co., Ltd.** (133,884).—Registered February 10th, by S. Morse, 1, Kingsway, W.C., capital, £50,000 in £1 shares. Objects: To carry on in the United Kingdom, Europe and elsewhere the business of tramway, railway, light railway, pier, motor-car, steamboat, motor-boat, omnibus, van, wagon, cab and carriage proprietors, store and garage keepers, carriers of passengers and goods, manufacturers of and dealers in motors, motor-cars, omnibuses and vehicles of all kinds, electrical and mechanical engineers, electricians, &c. The signatories (with one share each) are:—H. A. Stagg, 137, Boundaries Road, S.W., secretary; C. G. Tegetmeier, 1, Kingsway, W.C., director; W. L. Madgen, 1, Kingsway, W.C., electrical engineer; G. J. Somerville, 28, South Hill Park, Hampstead, N.W., electrical engineer; J. N. Gray, 45, Kent Road, Gravesend, secretary; T. J. Clements, 11, Danecroft Road, Herne Hill, S.E., secretary; T. Bower, 48, Victoria Road, Alexandra Park, N., secretary. Minimum cash subscription, seven shares. The first directors (to number not less than two or more than six) are C. G. Tegetmeier, W. L. Magden and G. J. Somerville; qualification (except first directors), 250 shares; remuneration, £50 each per annum (chairman, £100).

**Magneto and Taximeter Co., Ltd** (133 954).—This company was registered on February 13th, with a capital of £2,000 in £1 shares, to take over the business carried on by G. Kress, at 56, Goldhawk Road, Shepherd's Bush, W., as the "Magneto and Taximeter Co.," and as "Kress and Co." The subscribers (with one share each) are:—H. W. A. Hislop, Ingleside, Billericay, Essex, chartered accountant; S. H. Clinch, 45, Cumberland Park, Acton, W., chartered accountant; J. Schneider, 186, Easton Road, N.W., cane chair manufacturer. Private company. The number of directors is not to be less than three or more than seven; the first are G. Kress, W. Reineke and J. Schneider. Office, 56, Goldhawk Road, Shepherd's Bush, W.

**Elbon Metallising Co., Ltd.** (133.896).—This company was registered on February 11th, with a capital of £1,000 in £1 shares, to take over the business carried on by L. G. Lewis and W. B Tubbs, at 42, Berners Street, W., as the "Elbron Metallising Co." to carry on the electrolytic deposit of metals on non-metallic substances, &c. The subscribers (with one share each) are:—A. C. Crowl, 15, Harringay Gardens, Green Lanes, N., clerk; B. K. B. Barber, Linden Lodge, Trewsbury Road, Sydenham, S.E., articled clerk. Private company. The number of directors is not to be less than two or more than five: the first are W. B Tubbs, chairman, and L. G. Lewis, managing director (permanent), M. Dodds, and C. Tubbs. Solicitors, Carter Harrison & Armstrong, 39, Great James Street, Bedford Row, W.C.

**Irish Telephone (New System) Co., Ltd.** (8 980).—This company was registered in Edinburgh on February 10th, with a capital of £2,500, in £1 shares, to carry on the business of making and fitting up private telephones, telegraphs, &c. The subscribers (with one share each) are:—J. Levy, 36, West Princes Street, Glasgow, piano dealer; J. McMahon, Shouff Park House, Rutherglen, provision merchant. Private company. The number of directors is not to be less than three or more than seven; the first are C. Cochran, F. T. Jackson, J. Levy and J. McMahon; qualification, 50 shares. Registered office, 55, West Regent Street, Glasgow.

**Sceando Lamp Co., Ltd.** (133.906).—This company was registered on February 11th, with a capital of £100 in £1 shares, to carry on the business of manufacturers of, and dealers in, all kinds of electric lamps, &c. The subscribers (with one share each) are:—O. W. Porritt, Tor Side, Helmshore, woollen manufacturer; H. J. Osborn, Fern Bank, Gravel Lane, Wilmslow, engineer. Private company. Table "A" mainly applies. Registered office, 7, Blackfriars Street, Salford, Manchester.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Harvey Electro-Chemical Co., Ltd.**—Two charges on company's uncalled capital and other assets, dated January 15th, 1914, to secure £140 and £100 respectively. Holders: Major H. de L. Walters, Warren Farm House, Guildford; and J. D. Jones, 250, Westminster Bridge Road, S.E.

**Yale Electric Power Co., Ltd.**—Particulars of £3,000 debs., created December 23rd, 1913, and secured by trust deed dated January 19th, 1914, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's property, present and future, including certain leasehold lands and water rights in and near Festiniog, Merioneth. Trustees: Liverpool Mortgage Insurance Co., Ltd., 6, Castle Street, Liverpool.

**James Keith & Blackman Co., Ltd.**—Issue on February 9th, 1914, of £200 debentures, part of a series of which particulars have already been filed.

**Foster Engineering Co., Ltd.**—Mortgage dated January 30th, 1914, to secure £2,100 and further advances up to £3 000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: M. V. Ely, 26, Hill Road, Wimbledon, and E. Dobson, Chalgrove Lodge, Sutton, Surrey.

**Rhondda Tramways Co., Ltd.**—A memorandum of satisfaction to the extent of £700, on February 5th, 1914, of charges dated March 24th, 1911, and November 13th, 1912, securing £240,000, has been filed.

**Musselburgh and District Electric Light and Traction Co., Ltd.**—A memorandum of satisfaction to the extent of £100 on January 15th, 1914, of charges dated November 13th, 1905, and May 11th, 1909, securing £90,000, has been filed.

**Trowbridge Electric Supply Co., Ltd.**—A memorandum of satisfaction in full, on January 26th, 1914, of mortgage dated September 21st, 1911, securing £250, has been filed.

**Coast Development Corporation, Ltd.**—Charge on freehold land at Reyden, Suffolk, dated February 4th, 1914 (supplemental to charge dated April 18th, 1907, securing not more than £20,000). Holders: F. P. Matthews, Hearn Street, Curtain Road, E.C.; and E. J. Bellord, 8, Waterloo Place, S.W.

## CITY NOTES.

### South Metropolitan Electric Light and Power Co., Ltd.

The directors report that for the year ended December 31st, 1913, the revenue account shows a credit balance of £41,570, which, with £5,470 brought forward, made a total of £47,039. After deducting £13,461 for interest on debenture stock paid and accrued, and for other interest, and £6,504 for interim dividends paid on the preference shares, there remains a balance of £27,075. Out of this the directors recommend a final dividend upon the 7 per cent. cumulative first preference shares, absorbing £5,004; a final dividend to December 31st, 1913, upon the 6 per cent. cumulative second preference shares, £1,500; to depreciation account, £5,000; to reserve account, £10,000; and that £5,571 be carried forward.

The following comparative figures show the progress of the business:—

| Year. | Lamps (35-watt). Connected at end of year. | Increase. | Consumers. | Gross revenue. | Expenditure. | Net revenue. |
|---|---|---|---|---|---|---|
| 1910.. .. | 208,046 | 16,744 | 4,305 | £44,687 | £17,678 | £27,009 |
| 1911.. .. | 230,191 | 22,145 | 4,697 | 51,614 | 20,541 | 31,072 |
| 1912.. .. | 258,872 | 28,681 | 5,263 | 56,604 | 22,670 | 33,933 |
| 1913.. .. | 289,705 | 30,833 | 5,888 | 65,635 | 24,065 | 41,570 |

The new consumers and the lamps connected exceeded those added during 1912, when the number of connections was greater than in any previous year; and the net revenue shows a larger increase for 1913 than in any year since the formation of the company. The surplus profits, after placing £5,000 to depreciation account, represent a dividend of 8 per cent. on the ordinary shares, but the company is precluded by the provisions of the debenture trust deed from paying any dividend on the ordinary shares, until it has set aside to a special reserve fund a substantial sum, which during the past year amounted to £14 882. The West Kent undertaking is being actively developed in portions of its statutory area, with satisfactory results. The company having been formed in 1896, the articles of association, as altered by special resolutions, are both inconvenient for reference and out of date having regard to later legislation, and the directors propose the adoption of new articles to consolidate the existing regulations and make them accord with modern practice. For this purpose an extraordinary meeting is convened. By the new articles the number of directors is fixed at not more than five or less than three; provision is made for alternate directors; an article is inserted expressly authorising arrangements with the West Kent Electric Co., Ltd., and any other similar subsidiary company which may be controlled by the same board of directors.

The meeting is called for February 25th.

### Yorkshire Electric Power Co.

At the annual meeting held on February 17th, Mr A. G. Lupton, the chairman, said that the capital expenditure had been curtailed as far as possible, amounting in 1913 to £26,291, as against £53,036 in 1912, but the demand for current must be met, and the revenue was growing in a satisfactory proportion. The revenue for 1912 added 25 per cent. to the receipts for 1911, and that for 1913 amounted to over £61,000, as against £46,000 for 1912, a further growth of over 30 per cent. This left a profit of £15,401, and after paying the 6 per cent. dividend on the preference shares, £9,188 remained to be dealt with. They recommended that £5,000 of this be put aside as the beginning of a reserve fund, and the balance, £4,188, carried forward. It would be possible to pay a small dividend on the ordinary shares, but in view of the rapid growth of the company, and of the need to deal with the second mortgages on the undertaking, the directors considered that this would be unwise, although they hoped that the patience of the shareholders would not be much longer tried before a dividend would be reached on the ordinary shares. The cost of coal continued high, and there did not seem to be any immediate hope of relief in this. The 2,000-kw. turbine in the waste heat station at Barugh had been running satisfactorily on load since October, and owing to the great increase of demand for current, it had been already necessary to order a second turbine of 3,000 kw., which would bring the plant in that station up to 5,000 kw. This would soon be completed, and the capital required for it would be provided by the issue of further first mortgage debenture stock of the Waste Heat Co., bearing interest at 5½ per cent., secured by the lease of the station to the Power Co. Applications for the 6 per cent. preference shares, and the 5½ per cent. Waste Heat debenture stock, had been continuous throughout last year, and several had been received since the issue of the report for 1913. In July, 1908, when capital was needed to develop the company, it was decided to issue £45,000 second mortgages, carrying 6 per cent. interest, and repayable with a bonus of 5 per cent. The time to repay those had now come, and with that object the directors recommended that a further issue of £50,000 6 per cent. preference shares be authorised and offered to the holders of the second mortgages in exchange, the small balance being issued in the ordinary way, the dividend on this issue being at the same rate as the interest that has been paid upon the second mortgages. Holders of over £15,000 of the second mortgages had already signified their intention to make this exchange, and there was no doubt that when the proposal was approved by the shareholders, and the formal offer made, the bulk of the second mortgage holders would desire to secure this good return rather than have their capital repaid to them. Any mortgages which were not exchanged would be paid out in September, and this would clear the way when an issue of debenture stock became necessary, and would enable the company to use the borrowing powers for £45,000 to secure further capital at lower rates of interest than had been possible in the past. The object of their Bill, for an amending Act was partly financial, partly to increase the supply powers and generally to facilitate the development of the company. The financial clauses would enable the company to exercise its borrowing powers when shares were partly instead of fully paid as at present, to issue redeemable debenture stock instead of irredeemable only, and there were other clauses which were mostly of domestic interest, but one clause seemed to have excited considerable interest, and that was Clause 3, which enabled the current supplied by the company to be used for lighting in those places where no other supply was possible. In the original Act of 1901 the company was empowered, subject to certain restrictions in particular areas, to supply electric current for power purposes, and for lighting purposes on premises where power was used, but not for lighting alone. In the more populous places the company was supplying in bulk to local authorities and to companies who distributed for lighting, and their current was available to a very considerable population, but it had become apparent that the cost of these distributing orders was too great to make them practicable in the scattered and more rural districts, so that in many parts of the company's area the inhabitants were cut off from the use of electricity for lighting purposes, even though their mains might be passing their doors.

There was no difference whatever between the electric current which would drive a factory or a motor, heat a flat-iron, cook the dinner in an electric oven, or warm a sitting room by a radiator, yet these uses were all included in the powers of their Act, whilst the use of the same current for light was forbidden to the ordinary householder. It was as if in the area of a water company, the water might be sold for trade purposes, for washing and sanitation, but must on no account be drunk unless mixed with tea, cocoa, or whisky. Clause 3 had therefore been inserted in the company's Bill in response to many inquiries from residents in such districts who saw the company's mains close to them, but were unable to take advantage of the supply, because they only required it for lighting purposes and not for power, and the company were also receiving a large amount of support from the local authorities in such districts. The local authority of the district would not be in any way prejudiced if this power were granted. If they wished, they would be able at any time to take out an electric lighting order, but in the meantime their inhabitants would be able to obtain from the company what had now become almost a necessity of modern life. For some reason, a number of the larger local authorities, most of whom were in no way affected by the Bill, owing to the special protections they enjoyed, were petitioning against the Bill on this particular clause. It was the same blind policy which they pursued in 1901, when they opposed and tried to destroy the original Act, but he could hardly think that Parliament would approve their action or prevent the inhabitants of the rest of the West Riding from obtaining the advantages which they asked the company to give them. The Horbury Council had resolved to oppose the Bill after much talk about the company obtaining a monopoly. If the objectors had read the Bill, they would see that there was an absolute misunderstanding on their part. The only change asked for was that their ratepayers might be able, if they so desired, to use the current supplied by the company for light as well as for power, and, like any other local authority, they might apply for a provisional order if they desired to do so. Bearing this in mind, it was difficult to understand the reason for the Council coming to this decision. In 1904 the Council obtained an Electric Lighting Order, and although this company offered to give them a bulk supply, and the Distribution Co. offered to take over their order, nothing was done, and the Board of Trade eventually revoked their powers. If, instead of opposing the company, these municipal authorities would realise what it would mean to them and to their citizens to clear away the floating cloud of smoke which drifted backwards and forwards over the whole West Riding manufacturing area, and to let in sunshine, and health and cleanliness, and how the whole possibilities of life in their towns would be altered, they would give up this short-sighted opposition, and do all in their power to encourage and help the company; but it would seem that this was quite beyond the imagination of these Councillors or that of their legal advisers.

## Farnham Gas and Electricity Co.

The annual meeting was held on Monday evening, Mr. B. J. Nash presiding. The directors, in their report, recommended a dividend at the rate of £7 7s. per cent., less income-tax, for the whole year, this being the dividend permissible under the sliding scale clause in the Farnham Gas and Electricity Act. This, after deducting the interim dividend already paid, would absorb £923, and leave a balance of £753 to be carried forward. A most satisfactory increase in sales had been obtained from both branches of the company's business. The electricity department sold 67,927 units, as against 10,212 last year.

Mr. Ernest Crundwell, a director, pointed out that the gas capital was now practically £40,000, and the electricity capital £20,000. The effect of that upon the electricity portion of the undertaking was that, under their Act of Parliament they were bound to distribute the expenses common to the whole undertaking proportionate to the amount of capital of each portion of the undertaking. The electricity portion of the undertaking showed a loss of nearly £400, but that was arrived at after deducting the proportion of one-third of all the common expenses, whereas in the ordinary way, had it been a separate undertaking, a very small proportion of those expenses would have been attributable to it. Therefore, one wished to show that to that extent the gas portion of the undertaking was benefited and the electricity portion hampered and handicapped. With regard to the progress of the electricity portion of the undertaking, Mr. Crundwell remarked that they were now pumping the town sewage, and, he believed, perfectly satisfactorily, so much so that the company had been approached with a view to the extension of electric power to a new pumping station which it was proposed to erect. There was also every prospect that in the near future the whole or a greater portion of the town's water supply would be pumped by means of electric power.

The report was adopted.

## Electrical and Industrial Investment Co., Ltd.

The directors' report states that during the year £85,237 4½ per cent. debenture stock and £12,955 5½ per cent. debenture stock were issued at par, making the debenture and share capital issued at December 31st, 1913, £480,000. The directors recommend that the ordinary shares be divided into equal amounts of preferred ordinary shares of £1 each and deferred ordinary shares of £1 each, the preferred ordinary shares to be entitled out of the profits of each year to a preferential dividend at the rate of 7 per cent. per annum as from the passing of the necessary special resolution, and in a distribution of assets to priority of capital over the deferred ordinary shares; the deferred ordinary shares to be entitled to all surplus profits and assets. The directors have continued to act on the principle of adding to reserve the profits made on sales of investments and of charging losses on realisation against the reserve. The balance at the credit of reserve account at December 31st, 1913, was £24,224. The revenue account shows a profit, after payment of all management expenses and interest on debenture stocks, of £13,059, plus £3,314 brought forward, making £16,373. The directors have written off £3,091, the expenses of the debenture stock issue, and they recommend a dividend for the year on the 6 per cent. cumulative preference shares, carrying forward £7,282. At December 31st the company held 208 investments of the total book value of £588,430. On the basis of the middle market prices of the quoted securities (£365,197, equal to 62 per cent. of the total) at December 31st, and of the cost of the unquoted securities (£223,233, equal to 38 per cent. of the total), the assets after deducting the reserve, less the liabilities, are deficient by £4,868 to provide for the whole of the capital. This deficiency is equal to a depreciation of the quoted securities of 1·33 per cent., and has been more than neutralised by the rise in values since December 31st. Mr. Kingsford has resigned his seat on the board, and Mr. Charles H. Dade has been elected to fill the vacancy. Mr. J. A. Christie, owing to impaired health, does not seek re-election to the board, and the directors propose that Mr. Wm. Parker be elected a director.

**Cleveland and Durham Electric Power, Ltd.**—In the Chancery Division, Mr. Justice Astbury has sanctioned a scheme of arrangement of the Cleveland and Durham Electric Power, Ltd. Counsel said the scheme affected nobody, and, in reply to his Lordship, explained how the arrears of the preferential dividend amounted to £58,000. Up to 1910, he said, the dividend was cumulative, but, by special resolution passed at that time, the cumulative dividend was made non-cumulative. It was in respect of that large arrear that the company issued stock.

**Mather & Platt, Ltd.**—The report for 1913 states, according to the *Financial Times*, that the net profits for the year, after charging depreciation and directors' remuneration and expenses, are £164,524, plus the balance brought forward £35,506. The directors recommend a dividend for the year at the rate of 10 per cent. per annum on the ordinary shares (less interim dividend paid September), also a bonus of 5 per cent. on the ordinary shares, transferring to reserve account (bringing up the amount to £270,000), £50,000, and carrying forward £40,030.

**Companies Struck off the Register.**—The following companies have been struck off the Register, and are accordingly dissolved :—

Auto-Controllers.
Electrical Instrument Manufacturers.
Electro-Medical Institute.
Improved Electric Traction.
Mica Boiler Covering Co.
Midget Steam Trap Syndicate.
Phosphor Bronze Co., Ltd. (Registered 1874).
Solium Electrical Co.
Wimshurst Hollick & Co.

**London Electric Wire Co. and Smiths, Ltd.**—The directors, according to the *Financial Times*, recommend a dividend of 7½ per cent., less income-tax, on the ordinary shares for the half-year, making 10 per cent. for the year, placing £500 to depreciation reserve, making £2,500, £50,000 to extinguish goodwill, and carrying £22,673 forward.

**Chas. Clifford & Son, Ltd.**—The directors report a profit of £10,123 for 1913 after deducting debenture interest, depreciation, &c. After paying the preference dividend of 6 per cent. for the year, and 10 per cent. on the ordinary shares, £2,500 is transferred to reserve and £2,500 to debenture redemption reserve, carrying forward £5,014.

**Official Notices re Companies.**—The following companies will be struck off the Register, at the expiration of three months, unless cause is shown to the contrary :—

Bombay Hydro-Electric Syndicate.
Imeson Finch & Co.
Pearson Fire Alarm.

**Bruce Peebles & Co., Ltd.**—For 1913 the directors report more satisfactory results than in previous years. The net profit is £2,821. The company has obtained a fair share of orders at slightly improved prices.

**Newcastle and District Electric Lighting Co., Ltd.**—The directors recommend a final dividend at the rate of 5 per cent. per annum, making 4 per cent. for the year.

**Newcastle-upon-Tyne Electric Supply Co., Ltd.**—The directors announce a final dividend of 3 per cent., making 5½ per cent. for the year, on the ordinary shares. For 1912 the total was 5 per cent.

**Prospectuses.**—*Tramways (M.E.T.) Omnibus Co., Ltd.*—The Electric and General Investment Trust Co., Ltd., have this week been offering for sale £100,000—4½ per cent. guaranteed debenture stock in this company, at 92 per cent. The list was to close of Wednesday.

*Constantinople Telephone Co.*—The list is to close to-morrow in an offer of £200,000 6 per cent. obligation bonds at 97 per cent., the money being required for extensions consequent upon the large number of applications for service.

## Kensington and Knightsbridge Electric Lighting Co., Ltd.

THE directors' report for the year 1913 states that the renewal and reserve fund account now stands at £122,139, being an increase of £6,777. After providing for the amount placed to renewal and reserve fund account ["By provision for renewal and maintenance of buildings, plant, mains, &c., £15,974, less repairs and maintenance, £7,013=£8,961"] and after paying the dividends on the 6 per cent. first preference shares to 30th June, 1913, on the 5 per cent. second preference shares to 30th September, 1913, and an interim dividend at the rate of 8 per cent. per annum on the ordinary shares for the first half of the year, the balance standing to the credit of the net revenue account for the year 1913 is £9,933. Of the above sum £1,500 has been appropriated to the payment of the first preference dividend to the end of the year, and £625 has to be set aside to meet the portion of the dividend on the second preference shares accrued to the same date. It is proposed to pay out of the balance of £7,808 a further dividend on the ordinary shares at the rate of 10 per cent. per annum, for the past half-year, making with the interim dividend paid on August 14th, 9 per cent. for the year. This will leave £2,558 to be carried forward. The directors announce the death of Mr. R. S. Erskine who held the position of secretary to the company since its formation, and they put on record their extremely high appreciation of the sterling qualities of their late Secretary, to whose unremitting efforts the high standing of the company is very largely due. They have filled the vacancy caused by his death by appointing Mr. G. S. Britton who for a number of years has acted as assistant secretary to the company.

The meeting will be held on February 25th.

## London Electric Railway Co.

THE directors' report to December, 1913, states that the gross receipts of the railway were £715,319 and the expenditure was £332,856, leaving £382,463 plus miscellaneous receipts (net) from rents, interest, &c., £59,001, making the total net income £441,464, plus £3,107 brought forward. There have to be deducted interest, rentals and other fixed charges £215,259, appropriation to reserve £8,000, and dividend on preference stock £126,947, leaving a balance available for dividend on ordinary shares of £94,365. The interim dividend at the rate of £1 per cent. per annum, which was paid on the £10 ordinary shares for first half of the year ended 31st December, 1913, absorbed £46,639, leaving £47,726, which will admit of the payment of a dividend at the rate of £1 per cent. per annum for the second half of the year ended December 31st, 1913, making £1 per cent. for the year, carrying forward a balance of £1,086 after setting aside £8,000 for reserves. The dividends paid on the £10 ordinary shares for the year 1912 were at the rate of £1 per cent. per annum with a balance of £3,107 carried forward after setting aside £15,000 for reserve. The capital expenditure during the year amounted to £638,074. The extension of the railway from Edgware Road to Paddington was opened on December 1st, 1913, and the traffic is developing satisfactorily. Good progress is being made with the construction of the extension from Charing Cross to the Embankment, and it is hoped this will be opened for public traffic at an early date. The work on the Queen's Park extension and Oxford Circus escalators is also well advanced. Three bills were submitted for approval at yesterday's meeting. Lord George Hamilton, the late Chairman, having retired from the Board, the directors have elected Lord Farrer as chairman in his place, and Viscount Knollys has been elected to fill the vacancy on the Board created by Lord George Hamilton's resignation.

## London Electric Supply Corporation, Ltd.

THE directors' report for the year ended December 31st, 1913, states that the profit on working was £71,753, against £68,670 last year. Adding the amount brought forward, £4,706, and interest on deposit £75, there is a total of £76,534. From this there has been paid interest on debenture stock, 1913, £19,494, sinking fund for redemption of debenture stock in 1931, £12,000, leaving a balance to be appropriated of £45,040. It is now proposed to pay a dividend of 6 per cent. on the preference shares (of which an interim dividend of 3 per cent. was paid on September 1st, 1913), viz., £26,952, a dividend of 3 per cent. on the ordinary shares £9,990, to put to contingencies account £3,000, and to carry forward £5,098. The sinking fund of £12,000 a year, cumulative, for the redemption of debenture stock in 1931, now amounts to £24,756, in addition to the fund shown at the bottom of the capital account. The supply has been efficiently maintained during the year. The number of units sold amounted to 35,336,223, as against 28,409,755 last year; the total costs per unit sold being ·62d., as against ·66d. last year. The power supplied for traction purposes shows 13 per cent. increase, while the power supply for tramways and industrial purposes shows 60 per cent. over last year. The plant and machinery have been maintained out of revenue, and are in efficient condition. The directors record the death of their esteemed colleague, Sir William Preece, who had been a director of the Corporation since 1899. Mr. Oliver Bury has been elected to the board. The meeting is to be held on February 26th.

## Westminster Electric Supply Corporation, Ltd.

THE directors' report for the year 1913 states that the total power of the lamps, motors and apparatus connected to the company's mains, which on 31st December, 1912, was the equivalent of about 37,710 K.W., had increased by 31st December, 1913, to the equivalent of about 39,646 K.W. The length of roadway in which continuous current mains have been laid now exceeds 95 miles, making about 387 miles of ways, into which upwards of 282 miles of copper (strip and cable) have been drawn. In addition 6 miles of trunk mains (35 miles of ways) are laid in the Co's. area to connect the stations with the Central Electric Supply Co's. station at St. John's Wood. An interim dividend, at the rate of 10 per cent. per annum on the ordinary shares and the dividend on the 4½ per cent. preference shares, for the half-year ending 30th June, 1913, have been distributed. After allowing for depreciation, sinking fund and other charges, the net balance is £43,625, from which must be deducted the second half-year's dividend on the preference shares, which absorbed £11,653, leaving £31,972. Out of this the board recommend the payment of a dividend at the rate of 10 per cent. per annum, less Income tax, for the past half-year, making 10 per cent. for the year, carrying forward £6,078. The directors greatly regret the loss of the valuable services on the board of Mr. R. W. Wallace, K.C., who has ceased to be a director. Mr. E. A. Goulding, M.P., has been elected to fill the vacancy.

The meeting is called for February 25th, at Eccleston Place.

| | |
|---|---|
| Units sold (including A.C. supply of 1,500,360) ... | 21,906,196 |
| Used on works ... | 466,977 |
| Total ... | 22,373,173 |
| KW. on circuit, December 31st, 1913 ... | 39,646 |

## Charing Cross, West End and City Electricity Supply Co., Ltd.

THE directors' report for the year ended December 31st, 1913, says that the result of working has been satisfactory.

*West End Undertakings.*—The gross earnings of these undertakings from sales of current, rents, &c., were £151,240, as compared with £146,676 for 1912, and the expenses, excluding depreciation, were £66,866, as compared with £66,686 for 1912. The net earnings were £84,374, as against £79,990. After bringing in from the previous year the balance of £18,000, profits from the revenue account for 1913 £84,374, and interest accrued in 1913 £2,238, making together £104,612, and providing for interest on debenture stock £17,829, and setting aside for depreciation £22,000, there is a balance of net revenue of £64,782. Out of this have been paid the dividend on preference shares for the year £18,000, and an interim dividend for the first half of 1913 at the rate of 5 per cent. per annum on the ordinary shares, amounting to £10,000, leaving a balance to be dealt with of £36,782. The directors recommend that a final dividend be paid on the ordinary shares for the second half-year at the rate of 7 per cent. per annum, making 6 per cent. for the whole year, absorbing £14,000; that there be transferred to general reserve (income) account £4,782; and that there be carried forward £18,000. The company has now connected to its West-End mains a total equivalent of 703,693 (30-watt) lamps. The total is made up as follows:—454,037 in lighting, 31,845 in heating, and 217,811 (8,759 H.P.) in motive power.

*City Undertaking.*—The gross earnings of this undertaking from sales of current, rents, &c., were £149,819 for 1913, as compared with £148,513 for 1912; the expenses were £80,639, as against £84,959; and the net earnings were £69,180, as against £63,554. After bringing in the balance of £18,000 from 1912, and paying interest on the debenture stock, loans and advances (£30,853), there is a balance on net revenue account of £56,327, out of which has been paid the dividend on the preference shares amounting to £18,000, leaving £38,327, as compared with £18,000. The directors recommend that £20,327 be transferred to general reserve (income) account, and £18,000 carried forward. The company has now connected to its city mains the total equivalent of 688,421 (30-watt) lamps. The total includes 318,527 in lighting, 53,285 in heating, and 316,609 (12,732 H.P.) in motive power.

The chief engineer certifies that the plant and machinery at the several stations of the company have been maintained in a high state of efficiency.

By the London Electricity Supply Bill, 1914, the County of London Co. is seeking Parliamentary powers to enable it and other London supply companies to enter into agreements with the London County Council. The directors have considered the provisions of this Bill, and are taking the steps they deem necessary for the protection of the company's interests by lodging a petition to be heard before a Parliamentary Committee.

Mr. John D. Laurie, of the firm of Messrs. Laurie, Milbank & Co., of 31, Threadneedle Street, E.C., has been appointed a director of the company in place of the late Mr. Henry Campbell Pulley.

| | West End undertakings. | City undertaking. |
|---|---|---|
| Units generated .. .. .. .. | 9,910,661 | 28,596,509 |
| Units bought .. .. .. .. .. | 7,777,444 | 263,430 |
| Quantity sold—Public lamps .. .. | 558,827 | 22,602,693 |
| Other sales .. .. .. .. .. | 12,711,246 | — |
| Total B. of T. units sold .. .. .. | 13,270,073 | — |
| Used on works, and transmission and distribution losses.. .. .. .. | 4,418,032 | 6,257,246 |
| Total accounted for .. .. .. .. | 17,688,105 | 28,859,939 |
| Number of public lamps .. .. .. | 308 | — |
| Total maximum supply demanded in KW. | 6,716 | 12,683 |

The meeting is called for February 26th.

## Central London Railway Co.

The directors' report to December 31st, 1913, shows that the gross receipts of the railway, &c. for the year were £254,837, and the expenditure was £147,781, leaving £107,056, plus miscellaneous receipts (net) from rents, interest, &c., £36,502, making the total net income £143,558, plus £27,218 brought forward. There have to be deducted interest, rentals and other fixed charges £38,298, and dividends on 4½ per cent. preference stock £21,600, leaving a balance available for dividend on ordinary, preferred ordinary and deferred ordinary stocks, £110,878. The interim dividend at the rate of £3 per cent. per annum which was paid on the ordinary stock and at the rate of £4 per cent. per annum on the preferred ordinary stock for the first half of the year ended 31st December, 1913, absorbed £38,499, leaving £72,379, which will admit of the payment of a dividend at the rate of £3 per cent. per annum on the ordinary stock, at the rate of £4 per cent. per annum on the preferred ordinary stock for the second half of the year ended 31st December, 1913, and at the rate of £2 per cent. on the deferred ordinary stock for the whole year, making £3 per cent. on the ordinary stock and £4 per cent. on the preferred ordinary stock for the year, carrying forward a balance of £20,878. The dividends paid for the year 1912 were at the same rates, with a balance of £27,218 carried forward. The capital expenditure during the year amounted to £67,749. The Bill to empower the company to enlarge a portion of its railway tunnels; to construct new subways and works; and for other purposes was submitted for approval at yesterday's meeting, as was also the London Electric Railway Co.'s Bill to construct new subways. In accordance with the arrangements referred to in the last report regarding the proposals of the Underground Electric Railways Co. of London, Ltd., the following directors have resigned, viz.:—Dr. H. F. Parshall, Mr. Robert Fleming, the Rt. Hon. Viscount Knollys, the Rt. Hon. Lord Rathmore, and in their places have been appointed the Rt. Hon. Lord George Hamilton, Mr. Albert H. Stanley, the Rt. Hon. Viscount Knutsford and Colonel Sir Herbert Jekyll.

## Consolidated Diesel Engine Manufacturers, Ltd.

At an extraordinary general meeting of this company, that is to be held to-day, Friday, at Salisbury House, London Wall, E.C., shareholders will have before them a number of resolutions submitted by the majority of the Shareholders' Committee, and by certain individual members thereof. Those put forward by the majority read as follows:—

(A) That this meeting hereby approves and accepts the report of the majority of the shareholders' committee dated 7th February, 1914.

(B) That the provisional Agreement dated the 28th day of January, 1914, and made between Messrs. Alphonse, Georges, Gaston and Charles Carels, and Usines Carels Frères, Ltd., of the one part, and Mr. J. C. Inglis on behalf of the shareholders' committee of the other part, be and the same is hereby ratified, and that the directors be hereby authorised to carry the same into effect.

(C) That it is desirable to reconstruct the company, and accordingly that the company be wound up voluntarily and that Reginald Norton Dawson, F.C.I.S., of 356/9, Winchester House, Old Broad Street, in the City of London, be and he is hereby appointed liquidator for the purposes of such winding up.

(D) That the said liquidator be and he is hereby authorised to consent to the registration of a new company to be called British Diesel Oil Engines, Ltd., or some other suitable title, with a Memorandum and Articles of Association in a form to be approved by the directors of that company.

(E) That the draft Agreement submitted to this meeting and expressed to be made between this company and its liquidator of the one part and such new company of the other part be and the same is hereby approved, and that the said liquidator be and he is hereby authorised pursuant to Section 192 of the Companies (Consolidation) Act, 1908, to enter into an Agreement with such new company when incorporated in the terms of the said draft, and to carry the same into effect with such (if any) modifications as he may think expedient.

Mr. E. A. Richardson proposes as an amendment that the above resolutions be not adopted, but that a provisional agreement dated January 28th, 1914, made between Messrs. Alphonse, Georges, Gaston and Charles Carels, and Usines Carels, Ltd., of the one part, and J. C. Inglis on behalf of the shareholders' committee of the other part, be adopted; also that the Consolidated Diesel Engine Manufacturers, Ltd., be wound up voluntarily. Mr. J. M. Fells announces a resolution that he will move in the event of Mr. Richardson's resolution becoming the substantive motion; and the majority of the committee also have a recommendation that the expenses of the committee, &c., not exceeding £600, be paid.

The following are extracts from the "Majority" report:—

The committee see no reason to doubt the honesty and integrity of the directors, but the management of the affairs of the company has been characterised by an absence of business capacity. They further consider that in view of the difficulties which occurred, the directors should have consulted the shareholders at a much earlier period than they did. The unfortunate financial position of the company is not due to the general state of the industry itself. On the contrary, the leading Diesel engine manufacturers in this country have as much work as they can do for the next two or three years, and in the circumstances the company ought not to be in its present condition. After careful consideration your committee strongly recommend that the arrangement hitherto existing with Messrs. Usines Carels Frères should be determined. The committee found that there are outstanding obligations and loans to the extent of about £215,000 on the Ghent works. The obligations constitute a first charge on the Ghent property. In view of this and taking into consideration the fact that further large sums would have to be found for the development of Messrs. Carels' business—of which this company would be expected to find half—it is essential that the company's interest in Messrs. Carels should be disposed of. The committee have, therefore, concluded a provisional agreement with Messrs. Carels, subject to the sanction of the shareholders, for the purchase by Messrs. Carels, as individuals, of the 10,001 shares held by this company in their firm for £150,000, to be satisfied by the payment of £50,000 in cash or its equivalent and the surrender of the 100,000 fully paid £1 shares held by them in this company. Under this arrangement the shareholders will become sole owners of their property in England. The committee have given the most serious attention to the question whether legal proceedings should be instituted against the directors and others, but they have come to the conclusion that any such proceedings would be of doubtful advantage to the company, owing to the delay and great expense involved, and to the consequent depreciation of the assets and goodwill during the continuation of such proceedings. Moreover, the committee desire to point out that the full benefit of the agreement with Messrs. Carels can only be realized by a constructive policy, and that to complete the various large existing contracts new financial arrangements are urgently required. The chief consideration, however, is the very advanced state of the works at Ipswich. Members of the committee have personally inspected these works and are very much impressed with the design, equipment and condition of the property. With a further expenditure of £20,000 on heavy tools, the Diesel engines now being purchased from Messrs. Carels could be economically manufactured at Ipswich. This fact your committee think should weigh with the shareholders in deciding upon their future action. With the approval of the committee the unnecessarily large staff in the London office was considerably reduced in the month of December. The committee have considered various reconstruction schemes. That submitted by the directors to the meeting held on the 2nd December they have found to be open to two objections. (1) That the capital to be provided would be quite inadequate for carrying on the Ghent and Ipswich works combined; (2) that the commissions, underwriting and other expenses were excessive. To carry on the Ipswich works alone will require at least £100,000 fresh capital. In view of the very difficult situation that has arisen as well as of the great diversity of opinion which appears to prevail among the shareholders as to the best course to pursue, your committee have decided to ask them for a straight vote on the three alternatives open to them. *First.*—Reconstruction of the existing combination of Consolidated Diesel and Carels Companies. *Second.*—Sale of the Carels' shares and reconstruction on the basis of the Ipswich works alone, which the committee recommend. *Third.*—Voluntary liquidation. In the event of a sufficient majority being obtained for the second scheme the committee suggest that a new company be formed for the purpose of taking over the assets and liabilities of the existing company, the new company to have a capital of £500,000 divided into 1,000,000 shares of 10s. each, of which 750,000 will be issued. In the opinion of the committee the cash to be provided by scheme No. 2, detailed above, should be adequate to meet the future requirements of the company.

## Metropolitan Railway Co.

Lord Aberconway, P.C., presided on February 12th, at the offices, Baker Street, over the annual general meeting of the company. The large hall was crowded with shareholders.

The Chairman, in moving the adoption of the report (see Electrical Review, p. 281), referred to the fact that for the first time the directors met the proprietors on their own premises. The new building would accommodate the whole of the departments, and would enable them to effect economies in various directions. The report and accounts were, in the new form prescribed by the Railway Companies (Accounts and Returns) Act, 1911. The accounts covered the whole of the year 1913. The information given was very complete. As this was the first time the accounts had been prepared in this form and on an annual basis it was not possible to give comparative figures for the preceding year, but for their own purposes they had had a comparison made in the case of the more important items. In the cost of maintaining the motors and locomotives there was an increase of about £4,000, due partly to the increase in the mileage through the introduction of the new East London service, and partly to the higher prices of nearly all materials. The running expenses were £12,800 more, due partly to increased train services, but mainly to the higher price of coal. The price of fuel was very high all through 1913, but there were indications of better conditions in this respect during the current year, and they were already working at materially lower prices. The traffic expenses showed an increase of £6,600, due to the necessary increase in staff to work the East London service and to the enhanced wages paid to the men under the settlements come to with them at the end of 1912. To balance the increased expenses caused by the

running of the East London service they had received £15,000 more than in 1912 for work done on behalf of other companies, which included the running of the service on the East London Line between Whitechapel Junction and New Cross. The passenger train traffic decreased by £15,700. The falling off was confined exclusively to the short distance traffic and was caused by the increased motor 'bus competition. The season ticket traffic, however, increased by £4,500, and the longer distance traffic was steadily increasing, the proportion due to this company of the net earnings of the line north of Harrow being, for the year, £21,000, an increase of £5,500 over 1912. The goods, mineral and coal traffic continued to show a satisfactory development, being better by £6,500. The residential places served by the line north of Willesden were all showing signs of further development, and the prospects for a continued increase in the daily business traffic, which of course was one of their principal assets, were very good. Their rents were again a very satisfactory feature of the revenue account, as they showed an increase from new tenancies created of £4,500 over 1912. During the coming twelve months they would see a further substantial increase from this source. As to the working of the Great Northern and City line, they did not really take over the active management until 1st September. In the four months from September to December they had saved £1,600 in the working expenses of the line as compared with the previous year, which was at the rate of nearly £5,000 a year, in addition to which they had saved £1,260 for the half-year in the interest on debenture stock. The saving in expenses was in excess of the estimate given by the general manager to the shareholders' committee when they considered the scheme twelve months ago. The further saving in the cost of current would, of course, not be effected until the new substation was completed in the course of a few months. The traffic on the line showed a slight falling off for the half-year, but the revisions in fares made since 1st January were improving the earnings at the present time. During the year they had had many difficulties to contend with, and there had been many circumstances operating against them, and it had only been by the exercise of the greatest economy in working and by taking every opportunity of opening up new sources of revenue that they had been able to keep the net receipts up to practically the same level as 1912. They had reason to believe that in the current year the working costs would be more favourable in many directions, and that the traffic prospects were decidedly better. In regard to the item Appropriation to Reserve in the accounts, in 1912 they put £15,000 out of revenue to the electrical renewal and depreciation fund, which stood now at £65,900, after having borne during the last few years £47,000 in connection with the renewal of the generating plant at Neasden, which was now completed. They considered, having practically a new plant to-day that it was not necessary this year to make any addition to the electrical depreciation fund, but they proposed instead of doing so to commence a fund for general renewal purposes. They proposed to start this fund with £12,500, £7,500 of which was taken direct from last year's revenue, and £5,000 from a suspense account, which would otherwise have been credited to last year's figures. After making reference to the surplus lands stock, the Chairman said that the reconstruction of the whole of the company's generating plant at Neasden had been completed during the past year, and the economies that they expected by the change were being fully realised. They had also installed new grates for the boilers, which enabled them to burn a much lower grade of fuel than hitherto. They now had at Neasden a generating station which they considered was second to none, and their cost per unit generated was lower than it had ever been, and compared very favourably with the cost at other large power stations. They were now erecting a sub-station at Drayton Park for the purpose of distributing current from Neasden for working the Great Northern and City section. The necessary transforming machinery was being constructed at the Westinghouse Co.'s works at Manchester. They expected to have the new substation in operation by about the end of the half-year, and this would enable them to effect a very substantial economy in the working of that part of the line, and at the same time to reduce the cost of current at Neasden. By arrangement with the companies who were lessees of the East London line, they were providing the rolling stock and doing the whole of the working of that system, and he was glad to say that the traffic was showing a steady development month by month. They were also making improvements on the Hammersmith and City line, which was jointly owned by this company and the Great Western. Amongst other things they were building two new stations where the line crossed the Uxbridge Road and the Goldhawk Road respectively. They were also at the present time making final arrangements with the L. and S. Western Co. for exercising with electric traction their running powers to Richmond. This would enable them to run a through service from the City to Richmond *via* the Hammersmith line, and would incidentally improve the service between the stations on that line and the City. Their widening works on the Northern Extension line had made rapid progress, and they had brought certain sections of them into use. They would not be able to open the whole of the widening from Finchley Road to Wembley Park until the extension of the viaduct at Kilburn was completed some months hence, but meanwhile they would have the use of the additional lines both north and south of the Viaduct, and they would have the advantage of the automatic signalling all the way to Harrow. These facilities would enable them to improve their service to Harrow and beyond, and they were arranging to do so from the first of next month. They were promoting another Bill in the ensuing Session of Parliament, mainly with reference to the Great Northern and City line. The Chairman later dealt at some length with a circular (which he described as an extraordinary one) which had been issued by Mr. Pownall to the shareholders of the company. The result, however, of this circular, contrary no doubt to the intention of the author, had been the receipt of an unprecedented number of proxies in support of the Board and their policy.

Mr. Paul Speek seconded the motion.

Mr. Pownall addressed the meeting at great length with reference to the points he had set out in his circular to the proprietors and as to the reply issued by the Board in which they stated that his circular was full of untruths and misstatements. He maintained that the statements he had made were cold hard facts, every one of which could be verified. He quoted from letters by his solicitor to prove that his assertions as to certain share transactions by the Chairman and his wife and son were true, and also as to the financial stake which Sir Clarendon Hyde had in the company when he was elected a director. He reviewed the whole of the circumstances attending the acquisition of the Great Northern and City Railway, and suggested that there had already been a loss of £10,000 on it. The Metropolitan Co. had paid twice as much for the Tube as it was worth, but the Great Northern Co. could afford to lose considerably in order to gain additional conveniences for their long-distance travellers. He protested strongly against the proposal to raise £500,000 additional capital and asked for the support of the shareholders at the Warncliffe meeting to be held. The direction in which the railway should develop was to the west, and not out to New Cross. In conclusion, he proposed a vote of "no confidence" in the Chairman and his son, the Hon. Francis McLaren, M.P.

Mr. J. Hedges seconded the vote of "no confidence." He suggested that they wanted practical workers and not figure heads.

After further discussion, the Chairman said he believed Mr. Pownall was sincere in his views, but the shareholders had gone against him and he would ask him to fall into line with the majority. As to the accusations made that he and his family had been speculating in the funds of the company, there was no foundation for the charge. From the time he joined the Board he had never speculated in the shares of either that or any other railway company. The Chairman gave the details of his share transactions over a series of years, and said that he and his wife and son held between them nearly £52,000 of ordinary stock in the company.

The resolution of "no confidence" was put to the meeting, and, as the result of a show of hands, the Chairman said the voting was near but he thought the motion was defeated.

Mr. Pownall demanded a poll, which it was agreed should be taken at the close of the meeting.

The report was adopted, and Lieut.-Col. Probyn and Mr. P. Speek were re-elected directors. When the motion for the re-election of Sir Clarendon Hyde came on the motion was defeated on a show of hands, and the Chairman demanded a poll.

A motion to empower the Board to raise £750,000 of fresh capital as authorised by the Act of 1913 was also defeated, and the Chairman accordingly demanded a poll on this.

The meeting stood adjourned to enable the polls to be carried.

The poll resulted in the defeat of the "no confidence" in the Chairman and the Hon. F. McLaren resolution by 274,504 votes to 38,174. The motions for the re-election of Sir C. Hyde and for the motion to create new capital were carried by similar figures.

## Metropolitan District Railway Co.

The report of the directors shows that for the year ended December, 1913, the gross receipts of the railway were £789,662, and the expenditure was £383,132, leaving £406,530 plus miscellaneous receipts £116,542, making the total net income £523,072, plus £8,529 brought forward. There were to be deducted interest, rentals and other fixed charges £337,262, appropriation to reserve £20,000, and dividends on 4 per cent. guaranteed stock and 4½ per cent. first preference stock £124,930, leaving a balance available for dividend on the second preference stock of £49,409. The interim dividend at the rate of £2 10s. per cent. per annum which was paid on the second preference stock for the first half of the year ended 31st December, 1913, absorbed £18,375, leaving £31,034, which will admit of the payment of a dividend at the rate of £2 10s. per cent per annum for the second half of the year ended 31st December, 1913, thus making a dividend of £2 10s. per cent. for the year, carrying forward £12,659 after setting aside £20,000 for reserve. The dividends paid on the second preference stock for the year 1912 were at the rate of £2 per cent. per annum with a balance of £8,529 carried forward, after setting aside £20,000 for reserve. The capital expenditure during the year amounted to £100,621. The electrifica-

tion of the East London Railway has been completed and electric trains commenced running thereon on the 31st March, 1913. The work of constructing flying junctions at Earls Court has been completed, and the new line brought into use. The works in progress at Charing Cross Station which are being carried out in conjunction with the London Electric Railway Co. will be shortly completed. A satisfactory means of interchange will be established at this point between the Metropolitan District Railway and the Bakerloo and Hampstead lines of the London Electric Railway Co., and the station thus reconstructed must become a large exchange centre for passenger traffic between the three above-mentioned railways. The following Bills were submitted for consideration at a special general meeting held immediately after the ordinary meeting yesterday :—

"A Bill to empower the Central London Railway Co. to enlarge a portion of their railway tunnels; to construct new subways and works; and for other purposes."

"A Bill to empower the London Electric Railway Co. to construct new subways; and for other purposes."

"A Bill to confer additional powers upon the Midland Railway Co. and the Cheshire Lines Committee for the construction of works and upon that Company and Committee and the Midland and Great Northern Railways Joint Committee for the acquisition of lands; and for other purposes."

The company have sold, during the past year, £44,586 of prior lien debenture stock, the proceeds of which have been applied for the general capital purposes of the company. The directors have elected Capt. Wilfrid C. Dumble to fill a vacancy on the board.

## St. James' and Pall Mall Electric Light Co., Ltd.

Mr. Walter Leaf presided on Tuesday at the offices, Carnaby Street, over the annual meeting.

In moving the adoption of the report (See Elec. Rev. p. 283) the Chairman first referred to the serious illness which Mr. Walker, the managing director, had passed through, and congratulated him and the Co. on the fact that he was now, they believed, permanently re-established in health. The steady and normal increase in their sales had produced a total revenue of £146,000, as against £138,000 last year; an increase of £8,000. For this purpose they had purchased and generated about 800,000 units more than last year, at an additional cost of about £6,000, giving them apparently an additional profit from all sources of something over £2,000. These were, however, only part of the facts. They had to consider not only the figures of their own Co., but those of the Central Electric Supply Co., in which they were the partners with the Westminster Co. They were becoming each year more dependent on the bulk supply which was furnished by the Central Co., and this year their purchases of current amounted to £52,233, as against only £41,483 in 1912. The Grove Road works, as they knew, were admirably suited for the generation of electricity. They had adopted the most modern descriptions of turbine and boiler plant, and extensions were continually made to meet the requirements of the two purchasing companies. At present the directors had in hand large additions to the main generating plant, involving a capital expenditure of about £60,000, and from the experience which they had acquired, they were confident that this expenditure would be justified by a further reduction of the low working costs which had placed this fine power station in the forefront of such undertakings. As they were aware, their concessions expired in 1931, and as that date drew in sight, the question of raising additional capital repayable at the end of the term became a serious problem. If they were to go to the public to seek to raise fresh capital by a new debenture issue, the necessary sinking fund needed to repay the whole in less than seventeen years would form a serious burden on the undertaking, and one which would rapidly grow more onerous every year. It was therefore of the first importance that they should finance themselves during the remainder of their term out of their own resources. For this purpose the joint engineers had drawn up a careful and detailed estimate of the capital requirements of the Co. for the next ten years. That was as far as, at the moment, they need look forward. After full consideration, the board had adopted a scheme, due to the ability of the joint managers, by which the Central Co. could finance itself for this period by adding yearly a sum of something over £4,000 to the depreciation fund invested in the business. Their practice in the Central Co., by agreement with the supplying companies, had been to set aside annually a sum, increasing from year to year, and in 1912 amounting to £13,500, of which two-thirds had been invested in the names of the trustees of the Co. jointly, to form a sinking fund for the redemption of the debentures, while the other one-third had been invested in the business. After setting aside this sum and paying each of the companies a dividend of 5 per cent. on their holdings, the price of the current charged had been fixed at the lowest figure per unit which would balance the revenue account. Thus the additional sum which the Board had decided to set aside for the depreciation account was provided by an increase in the price per unit charged to the purchasing companies, and if they referred to the accounts of the Central Co., they would find that instead of £13,500 as in 1912, they had in 1913 charged £18,574 to the depreciation account, of which £10,000 had been placed to the sinking fund, and the balance of £8,574, or £4,000 more than last year, had been invested in the business as depreciation fund. By maintaining that allocation they would not only make provision for all new capital expenditure so far as they could forsee it, but still offer additional security both to the debenture holders and the shareholders for the due repayment of capital in 1931. And this additional security had been obtained by charging these companies about £2,000 more for current than they would otherwise have had to pay. In other words, about £2,000 of their profits had been put away to reserve in the Central Co. He was anxious to make that point quite clear before he said anything about the dividend. Taking the accounts of the St. James' Co. by themselves, it would appear that they were proposing to increase the dividend on the ordinary shares by £4,000, when they had really only made £2,000 more profit, and that they had provided the additional £2,000 by reducing the sum passed to credit of the contingency fund. He hoped he had made it clear that this was not so, and that they had in fact, after providing practically the same amount as in 1912 for their own depreciation, a little over £16,000, again set aside £4,500 as in past years for contingencies, only instead of adding the whole to their own contingency fund, they had taken £2,000 for a similar purpose in the Central Co., and of course the Westminster Co. had done the same. It was not for him to prophesy as to the maintenance of the dividend of 12 per cent which they now proposed. He could only tell them that they were placing to reserve, in one form or another, a sum which after consultation with the auditors, they held to be such as prudent men should set aside having regard to the experience they had had in the past, and the most careful estimate they could make of the future. They might, of course, be affected again by some such difficulty as that caused by the advent of the metallic filament lamp, but they did not at the moment see the quarter from which such an event was likely to come upon them. They were still engaged, and doubtless would always be engaged, on scrapping plant which had grown out of date. One such considerable undertaking, of which they had told them in past years, had now been nearly carried through, and had been financed out of the provision they had made for it from revenue. Others would follow on it, and they proposed to provide for them in the same way. And before they asked the shareholders to vote for the increase, he would like to say he was sure they had made as ample provision for all contingencies as any electric supply company in London. Few, if he might say so without invidious comparison, had done nearly so much. He must refer to another matter which many of them had doubtless seen in the Press and upon which they might wish him to say a few words. A bill had been promoted in the name of the County of London Co. called the "London Electric Supply Bill," with the object, apparently, of attempting to secure a revision of the existing conditions and an extension of tenure for the whole of the London electric supply companies. They had no part in the inception or drafting of that bill, and heard of it first only through the public advertisement. They were therefore free to express their views impartially. They would, of course, be glad to have an extension of their life beyond the forty-two years given in their order, but it was essential that they should have a voice in the terms on which that extension was to be obtained. Of those the bill itself contained no hint. And when they found that it proposed to override the Act of 1908, which by regulating their position towards the County Council, gave them rights which they deemed to be of the utmost importance to them, and they could not accept it in a blank. They must at least be in a position to discuss on an equal footing the terms, possibly very onerous, on which the County Council might be willing to grant an extension of their Order, and they had therefore in the interests of the Co. joined with other companies in presenting a petition against the Bill. They had doubtless heard that they had been approached by a financial group which desired to effect, under the form of a large holding Co., an amalgamation of all the electric supply companies of London. Of that scheme he could not say much at the moment; it was still under consideration by a conference, and he had no right to anticipate their decision. He could only say that they were not as yet satisfied that the scheme would effect the economies and secure the profits which it promised, and they were awaiting further information. But with regard to their own Co. in particular, he must add that the proposal in its present form was unacceptable as it failed to recognise the exceptionally strong position which that Co. had, with a few others, attained by prudent and conservative management in the past. He must ask them to rely on the board to protect their interests in that respect. As soon as any scheme was presented to them which was satisfactory on that as on other points, they would lose no time in calling the shareholders together and laying it before them. In the meantime he would ask them not to pay too much attention to irresponsible statements appearing in the Press from possibly interested sources, but to continue to the board the confidence on which it had always been their privilege to reckon in the past.

Mr. Pryor seconded the motion, and it was carried without discussion.

## Notting Hill Electric Lighting Co., Ltd.

The directors in their report state that during the year ended December 31st, 1913, the expenditure on capital account at the date of the last balance-sheet stood at £249,608. It now stands at £247,992. During the past year £3,916 has been realised by the sale of surplus lands. The expenditure on capital account exceeds the receipts by £38,640. The cost of the joint station at Wood Lane to date has amounted to £224,463, and joint debenture stock amounting to £231,500 has been issued. The redemption of this stock is secured by cumulative sinking funds, which now amount to £59,079 invested in trustee securities. The following table shows the progress of the company :—

| | | | Profit. |
|---|---|---|---|
| 1910 | Equivalent of 8-c.p. lamps connected. | 189,825 | £22,002 |
| 1911 | " " | 199,156 | 23,557 |
| 1912 | " " | 211,338 | 24,436 |
| 1913 | " " | 222,350 | 24,465 |

The number of consumers is now 4,027, and with the exception of 27, they are supplied at 200 volts. The gross revenue for the year was £46,118, showing an increase of £1,338. From the available net profit of £25,562 have to be deducted the following sums :—Depreciation, renewal and reserve fund, £3,000 ; debenture interest, £2,411 ; Kensington and Notting Hill joint debenture stock—debenture interest, £2,581 ; sinking funds, £1,586 ; interest on loans, £376 ; amount to be distributed to staff under co-partnership scheme, £265 ; leaving a balance available for dividend of £15,343. Both classes of 6 per cent. preference shares have already received their full dividend, which absorbs £8,136, and leaves a balance of £7,207 available for dividend on the ordinary shares. The directors therefore recommend the payment of a dividend of 5s. per share, less tax, on the ordinary shares, absorbing £6,368, carrying forward £839. The scheme of co-partnership with the company's staff, brought into operation during 1912, is working satisfactorily, Under this scheme there will be distributed among the staff an addition to their wages of 8 per cent. The directors regret to have to report that Mr. Geo. Schultz, who has been the engineer and manager to the company since its formation, has been compelled to withdraw from active work for reasons of health. In view of his long service and intimate knowledge of the undertaking, the directors have appointed him consulting engineer to the board. Mr. R. G. Rawkins, who has held the position of secretary since the opening of the works, has been entrusted with the duties of manager, and Mr. A. P. McDouall, who has been for some years assistant engineer under Mr. Schultz, has been appointed chief engineer.

The meeting will be held on February 25th, at Winchester House, E.C.

| | |
|---|---|
| Units generated and purchased | 3,469,624 |
| Units sold—Public lamps | 102,528 |
| Private consumers by meter | 2,478,707 |
| Total sold | 2,581,230 |
| Units used on works | 15,843 |
| Total units accounted for | 2,597,073 |
| Units expended in distribution | 872,551 |
| Number of public lamps | 53 |
| Total max. supply demanded in kw. | 1,740 |

**Cambridge Electric Supply Co., Ltd.**—The directors' report shows during the year ended December, 1913, there were connected 235 additional consumers, and the number of units supplied was 930,554, an increase of 119,851 units. The profit was £11,302, plus £984 brought forward. After deducting debenture and other interest £1,832, placing £4,000 to depreciation fund account, there remains a balance of £6,454. An interim dividend of 2½ per cent., absorbing £2,170, has already been paid, and the directors recommend the payment of a further dividend of 3½ per cent., making 6 per cent. for the year. This will absorb £3,084, leaving £1,200 to carry forward. Of the 577 shares which were offered to the shareholders, 369 were taken up at a premium of £2 per share, which premium will be transferred at a later date to the depreciation fund account or to reserve, as may be thought best. There remain a further 208 shares which are again offered to the shareholders at the same premium. Mr. J. B. Simpson has decided not to seek re-election as a director. He has been a director of the company since its formation, and his services have been of very great value. The meeting takes place at Cambridge on February 25th.

**City of London Electric Lighting Co., Ltd.**—Subject to the completion of the audit, the directors are placing £50,000 to reserve and recommending the following dividends :—Preference shares, 12s. per share (6 per cent. per annum). Ordinary shares, 20s. per share, being at the rate of 10 per cent. per annum. On account of these dividends 6s. per preference share and 6s. per ordinary share was paid in September, 1913. After transferring the balance of the dividend equalisation fund to profit and loss and providing for other appropriations, there remains about £27,000 to be carried forward. For 1912 the ordinary dividend was 9 per cent.

**W. T. Henley's Telegraph Works Co., Ltd.**—Subject to audit, the directors have decided to recommend a dividend on the ordinary shares of 15 per cent., free of income-tax, including the interim dividend of 5 per cent. paid August 31st last, and also, consequent on the success of the company's "Why Not" golf balls, a bonus of 5s. per share on the ordinary shares, free of income-tax. The transfer books will be closed from February 28th to March 5th, both days inclusive. For 1912 the total distribution on the ordinary shares was 15 per cent.

**Northampton Electric Light and Power Co., Ltd.**—For the year 1913 the directors state that they are again able to report a steady expansion of the company's operations. Lamps and motors have been added (32-watt lamps) 13,311, making a total equal to 158,898 lamps. The increase in H.P. of motors is 316, making a total of 3,041 H.P. The mains added were 1,576 yards, making a total of 30 miles 1,464 yards. In addition to this, new feeder ducts have been laid in various directions, the increase amounting to 1,301 yards. The output of electricity has been 3,468,981 units, compared with 3,108,113 in the previous year. The maximum load on plant was 2,111 kw. Substantial additions to the buildings and generating plant have been made. In view of future requirements it has been found advisable to acquire further property in Angel Lane and Fetter Lane. The general depreciation account has been increased by £5,200 (out of which certain specific items have been written down), also £375 has been written off motors, and £1,500 added to reserve. The sum of £750 will be required for the dividend on the 5 per cent. preference shares, and the directors propose that 7 per cent. per annum should be paid on the ordinary shares for the half-year (making 6 per cent. for the year) £2,450, leaving £2,408 to be carried forward. It is now necessary to increase the capital of the company, and, to this end, a resolution will be submitted to the shareholders.

The meeting takes place at Northampton on February 26th.

**Electrical Distribution of Yorkshire, Ltd.**—The directors report that the net profit for the three years ending December 31st is as follows :—1911, £1,347 ; 1912, £1,903 ; 1913, £2,569. The balance brought forward from 1912, after payment of directors' remuneration, was £485, and adding the profit for 1913, there is a disposable balance of £3,054. The directors recommend that this balance should be dealt with as follows :—A dividend for 1913 at the rate of 6 per cent. per annum on the ordinary shares, £1,418, adding to the reserve fund £1,000, and carrying forward, subject to any remuneration voted to the directors, £636. During the year the company has acquired by transfer the electric lighting provisional orders promoted by the Urban District Councils of Birstall and Greetland. The number of consumers of the company's supply is steadily increasing. At the date of the last report to the shareholders 4,865 shares of £1 each had not been applied for. These shares have now been allotted and fully paid. At extraordinary meetings of shareholders held on February 25th and March 18th, 1913, a resolution was passed and confirmed increasing the nominal capital of the company from £25,000 to £50,000. In order to develop the undertakings of the company further capital will shortly be required. The issue will be offered to the shareholders in proportion to their holdings. The meeting takes place at Leeds on February 24th.

**Crossley Bros., Ltd.**—The directors' report for the year ended December 31st, 1913, shows that the amount to the credit of revenue account is £78,670, out of which a dividend has been paid on the preference shares at the rate of 5 per cent. per annum for the first half of the year, amounting to £10,085. It is proposed to pay a further dividend for the second half of the year at the rate of 5 per cent. per annum on the preference shares, amounting to £10,085, to place £20,000 to the reserve fund, and to carry forward the balance of £38,501 to next account. Mr. John Dempster, having left Manchester, has resigned his seat on the board. The meeting will be held at Manchester, February 25th.

## STOCKS AND SHARES.

Tuesday Evening.

The halt in the pace of the rise, to which attention was drawn here last week, has lengthened into a pause. A few days ago, day-to-day money showed signs of getting a little stiffer, which had a damping effect upon gilt-edged securities, and through them upon Home Railway and many other investment stocks. Political events at home and abroad combined with other matters, the majority being of small consequence, to emphasise the sagging of prices that started when it became obvious that the public had ceased to buy in large amounts. The House all round was infected with the spirit of dulness, and the next developments are awaited with some vivid interest. Markets took a turn for the better on Tuesday afternoon.

The Electric Lighting companies give an excellent account of themselves in their dividend declarations in respect of the past half-year. Several have raised their dividends, the St. James's, City of London, Charing Cross, and Kensington being amongst them, while two or three are expected to follow in the same direction. Charing Cross shares responded to the announcement, but the rest of the market is quiet, tending a little to the dull side, much of the recent steam having evaporated from its energy. If the Stock Exchange as a whole were to wake up into renewed strength, electric lighting shares would, doubtless, participate in the movement ; but until such a lead is afforded, it may be surmised with safety that this department will not strike out a line of its own.

City Lights are ¼ easier at 18½, those who bought in advance of the dividend increase not having been supplemented by further purchasers. At 18½ *cum* 14s. dividend, the yield on the shares is £5 12s. 6d. per cent. Speculation interests itself in the probabilities of the County of London's Bill being passed in the current

session of Parliament, although it is thought that the matter will not come up for debate until later on. Metropolitan and Urban Preference are firmer, while London Electric and County Preference lost ¼. Debenture stocks are still exceedingly scarce, with the demand for them as keen as ever. The public are taking little interest in the market generally, and those who have been responsible for the recent advances are resting upon their oars, feeling that the lack of business in stocks and shares supplies a reason for the comparative lassitude of prices.

In the Electric Railway section there rests a fair amount of firmness. Metropolitans and Districts are ¼ to ½ lower unchanged. District 4 per cent. Debenture stock is 1 higher, and Central London 4½ per cent. Preference rose 3 to 104. Underground Electric Railway shares eased off to 8s. 9d., and the 6 per cent. Income bonds hardened upon the company's financial statement, given here last week; later, there was a slight reaction. The Home Railway market is none too pleased with Lord Claud Hamilton's statement that his company—the Great Eastern—had to go to the United States in order to get the general manager most suitable for the line; and the view prevails that such a step, with its public proclamation at the company's meeting, is a blow to ambition and initiative on the part of the British Railway staffs, especially those employed in the most responsible kind of work. East Londons gained a little, the old rumour being circulated that the Port of London Authority wanted to buy the line. The Midland Railway, by the way, is asking for powers to extend for a couple of years the time fixed by Parliament for the commencement of the electrification work on its Southend Railway.

Lancashire United Debenture rose 2 points, and Hastings Debenture is also higher. London United Tramways Debenture eased off to 65, but Metropolitan Electric Tramways Debenture stocks have both improved, after their previous good rises. North Metropolitan 6 per cent. Preference stock has been rising, on steady demand from investors and the price is now quoted at 109½ middle. The Electric and General Investment Company has been offering £100,000 Guaranteed 4½ per cent. Debenture stock, at 92, of the Tramways (M.E.T.) Omnibus Company, Limited.

Mexican bonds and stocks are mainly lower. Recent news from the country has been largely composed of items telling of small attacks upon railway and other joint stock property—none of them particularly serious, but interpreted as an indication of the temper towards the foreign undertakings on the part of the revolutionaries. In consequences of this, Mexican Light and Power Common followed up its last week's drop of 7 points with a small further decline. Mexican Electric Light bonds are 1 down, Mexico trams have given way more sharply, and Monterey Debenture reverted to 58½. It takes so little business, either of buying or selling, to move these Mexican quotations considerably that, as we have pointed out before, too much importance should not be laid upon movements that in other securities would be regarded as substantial.

The Canadians are generally firm. Shawinigan Capital stock hardened to 146, British Columbia Electric Railway stocks are better, and Canadian Generals hold their prices; while, of the bonds, Shawinigan Firsts are 1½ higher. Victoria Falls Preference went back to 15s. 7½d. upon the underwriters getting left with the greater part of the new issue of Second Debenture stock recently made by the company; the price has declined to 4 discount.

The Anglo-Argentine Tramways new Debenture stock keeps at ¼ premium for delivery at the end of the month. Evidently there are stags about who have not yet disposed of their allotments: and as the rush for new issues has given place to a much more sober demand, scrip stocks are less popular. The 4 per cent. Debenture stock is a little lower at 93½, City of Buenos Ayres Trams reacted to 5½, and Para Electric Railways shares have lost another ½.

The Telegraph market is steady. Great Northerns rose to 33½, and in the Eastern group Eastern Extension Ordinary is better, though "Chinas" lost ½. Commercial Cable Debenture stock rose to 82½. Anglo-American Telegraphs are irregular, the Preferred stock being unchanged, while the Deferred fell ½ to 24⅝. Submarine Cables Trust certificates have been wanted, New York supplying buyers. West India and Panama shares reacted to 2¹¹⁄₁₆, as speculative markets in other parts gave way. There has been a little selling of Marconi shares. The impression is that if the miserable affair has to be gone over again, in the House of Lords, with Lord Murray as the principal character, its effect will be to stifle interest in the shares, from the Stock Exchange point of view, although it may titillate the appetite of those who are not already tired of the unsavoury business. The rest of the group is affected by the dulness in the parent shares.

The Manufacturing division shows a fair number of rises. Telegraph Constructions improved to 40 upon the declaration of the usual dividend and bonus, making 20 per cent. for the year. Henleys jumped up 7s. 6d. to 14½, thanks to the declaration of a bonus of 5s. per share in addition to the usual 15 per cent. dividend, the former due to the success of the company's golf ball "Why Not." Those who play with it may be tempted to apply the same question to the consideration that, as the price of rubber has fallen so much, that of golf balls might be lowered in proportion. One can well understand, however, the non-golfing shareholder of Henley's feeling extremely satisfied at the success which the company has achieved in the "Why Not" direction. Callenders are better at 11⅛, and there are small improvements in Babcock and Wilcox, Castner-Kellner, and Edison £2 paid shares. British Aluminium Debenture stocks are strong, the Seconds jumping to 92½, three points higher than they were a week ago. Rubber shares are an erratic market, for, after being exceedingly buoyant at the end of last week, they fell upon reaction directly afterwards, although the decline was marked by steady buying of most of the investment shares as the prices gave way here and there.

## MARKET QUOTATIONS.

**It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.**

### Wednesday, February 18th.

| CHEMICALS, &c. | | Latest Price. | Fortnight's Inc. or Dec. |
|---|---|---|---|
| *a* Acid, Hydrochloric .. .. | per cwt. | 5/- | .. |
| *a* „ Nitric .. .. .. .. | „ | 22/- | .. |
| *a* „ Oxalic .. .. .. | per lb. | 3d. | .. |
| *a* „ Sulphuric .. .. .. | per cwt. | 5/6 | .. |
| *a* Ammoniac Sal .. .. .. | „ | 42/- | .. |
| *a* Ammonia, Muriate (large crystal) | per ton | £30 10 | .. |
| *a* Bleaching powder .. .. .. | „ | £6 5 | .. |
| *a* Bisulphide of Carbon .. .. | „ | £18 | .. |
| *a* Borax .. .. .. .. .. | „ | £17 10 | .. |
| *a* Copper Sulphate .. .. .. | „ | £22 10 | .. |
| *a* Lead, Nitrate .. .. .. | „ | £30 10 | .. |
| *a* „ White Sugar .. .. | „ | £28 | .. |
| *a* „ Peroxide .. .. .. | „ | £32 | .. |
| *e* Methylated Spirit .. .. .. | per gal. | 2/6 | .. |
| *a* Potassium, Bichromate, in casks | per lb. | 8½d. | .. |
| *a* Potash, Caustic (88/50 %) .. | per ton | £22 10 | .. |
| *a* „ Chlorate .. .. .. | per lb. | 8½d. | .. |
| *a* „ Perchlorate .. .. | „ | 4½d. | .. |
| *a* Potassium, Cyanide (98/100 %) .. (for mining purposes only) | „ | 7½d. | .. |
| *a* Shellac .. .. .. .. | per cwt. | 82/- | .. |
| *a* Sulphate of Magnesia .. .. | per ton | £4 10 | .. |
| *a* Sulphur, Sublimed Flowers .. | „ | £8 10 | .. |
| *a* „ Recovered .. .. | „ | £5 10 | .. |
| *a* „ Lump .. .. .. | „ | £5 | .. |
| *a* Soda, Caustic (white 70/72 %) .. | „ | £10 5 | .. |
| *a* „ Chlorate .. .. .. | per lb. | 8⅝d. | .. |
| *a* „ Crystals .. .. .. | per ton | £8 5 | .. |
| *a* Sodium Bichromate, casks .. | per lb. | 3d. | .. |
| **METALS, &c.** | | | |
| *b* Aluminium Ingots, in ton lots .. | per ton | £86 | .. |
| *b* „ Wire, in ton lots (1 to 14 S.W.G.) | „ | £112 | .. |
| *b* „ Sheet, in ton lots .. | „ | £112 | .. |
| *p* Babbitt's metal ingots .. .. | „ | £50 to £221 | .. |
| *c* Brass (rolled metal 2" to 12" basis) | per lb. | 7⅛d. | .. |
| *c* „ Tube (brazed) .. .. | „ | 9⅛d. | .. |
| *c* „ „ (solid drawn) .. | „ | 8⅛d. | .. |
| *c* „ Wire, basis .. .. .. | „ | 7⅛d. | .. |
| *c* Copper Tubes (brazed) .. .. | „ | 10½d. | .. |
| *c* „ „ (solid drawn) .. | „ | 10½d. | .. |
| *g* „ Bars (best selected) .. | per ton | £83 | .. |
| *g* „ Sheet .. .. .. | „ | £83 | .. |
| *g* „ Rod .. .. .. .. | „ | £83 | .. |
| *d* „ (Electrolytic) Bars .. | „ | £68 10 | .. |
| *d* „ „ Sheets .. | „ | £86 10 | .. |
| *d* „ „ Rods .. | „ | £74 | .. |
| *d* „ „ H.C. Wire | per lb. | 8¾d. | .. |
| *f* Ebonite Rod .. .. .. | „ | 4/6 | .. |
| *f* „ Sheet .. .. .. | „ | 4/- | .. |
| *n* German Silver Wire .. .. | „ | 1/10 | .. |
| *h* Gutta-percha, fine .. .. | „ | 7/- | .. |
| *h* India-rubber, Para fine .. .. | „ | 3/1 | ½d. dec. |
| *l* Iron Pig (Cleveland warrants) .. | per ton | 51/9 | 4d. inc. |
| „ Wire, galv. No. 8, P.O. qual. | „ | £14 | .. |
| *g* Lead, English Pig .. .. .. | „ | £19 17 6 | 12s. 6d. dec. |
| *m* Manganin Wire No. 28 .. .. | per lb. | 6/6 | .. |
| *g* Mercury .. .. .. .. | per bot. | £7 10 | .. |
| *e* Mica (in original cases) small .. | per lb. | 6d. to 8s. | .. |
| *e* „ „ „ medium | „ | 3/6 to 6/- | .. |
| *e* „ „ „ large .. | „ | 7/6 to 11/- | .. |
| *o* Nickel, sheet, wire, &c. .. .. | „ | 3/6 to 4/6 nom | .. |
| *p* Phosphor Bronze, plain castings | „ | 1/1 to 1/3½ | .. |
| *p* „ „ rolled bars & rods | „ | 1/0⅝ to 1/3 | .. |
| *p* „ „ rolled strip & sheet | „ | 1/2½ to 1/5½ | .. |
| *o* Platinum .. .. .. .. | per oz. | 185/- | .. |
| *d* Silicium Bronze Wire .. .. | per lb. | 10½d. | .. |
| *r* Steel, Magnet, in bars .. .. | per ton | £55 | .. |
| *g* Tin, Block (English) .. .. | „ | £179 10 to £180 10 | £8 10 dec. |
| *n* „ Wire, Nos. 1 to 16 .. .. | per lb. | 2/5 | .. |
| *p* White Anti-friction Metals .. | per ton | £44 to £194 | .. |
| *k* Zinc, Sh's (Vieille Montagne bnd.) | „ | £25 12 6 | .. |

**Quotations supplied by—**

*a* G. Boor & Co.
*b* The British Aluminium Co., Ltd.
*c* Thos. Bolton & Sons, Ltd.
*d* Frederick Smith & Co.
*e* F. Wiggins & Sons.
*f* India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
*g* James & Shakspeare.
*h* Edward Till & Co.
*l* Bolling & Lowe.
*k* Morris Ashby, Ltd.
*l* Richard Johnson & Nephew, Ltd.
*m* W. T. Glover & Co., Ltd.
*n* P. Ormiston & Sons
*o* Johnson, Matthey & Co., Ltd.
*p*
*r* W. F. Dennis & Co.

**Manila Electric Railroad and Lighting Corporation.**—According to the financial Press, the directors have resolved to create a British Advisory Board, consisting of three members, and Sir William Garstin, Mr. Leonard Govett, together with Mr. A. N. Connett, have been appointed to serve in this capacity. It is stated that the appointment of an English Board should enable the large number of English investors associated with the undertaking to secure through their newly appointed representatives a greater participation in the councils of the undertaking than they have hitherto enjoyed.

**North Metropolitan Electric Power Supply Co.**—A meeting is called for March 2nd to authorise the company to raise £100,000, a further portion of the additional capital authorised by the Act of 1909.

# SHARE LIST OF ELECTRICAL COMPANIES.

## ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

| NAME. | Stock or Share. | Dividends for 1912. | Dividends for 1913. | Closing Quotations Feb. 17th. | Rise + or Fall — | Present Yield p.c. |
|---|---|---|---|---|---|---|
| | * | | | | | £ s. d. |
| Bath Trams, Pref. Ord. | 1 | Nil | .. | ⅜ — ⅝ | .. | Nil |
| Do. 5 % Pref. | 1 | 5 | 5 | ⅞ — 1 | .. | 6 13 4 |
| Do. 4½ % Deb. | 100 | 4½ | 4½ | 70 — 75 | .. | 6 0 0 |
| Brit. Elec. Trac., 6 % Pref. | 100 | .. | .. | 16½ — 18½ | + ½ | .. |
| Do. Do. Deferred | 100 | .. | .. | 7½ — 9½ | .. | .. |
| Do. Do. 6 % Cum. Pr'f. | 100 | 6 | 6 | 90 — 93 | .. | 6 9 0 |
| Do. 7 % Non-Cum. Pr'f. | 100 | 3 | .. | 57 — 60 | .. | 5 0 0 |
| Do. 5 % Perp. Deb. | 100 | 5 | 5 | 93 — 96 | .. | 5 4 0 |
| Do. 4½ % 2nd Deb. | 100 | 4½ | 4½ | 80 — 83 | .. | 5 8 5 |
| Central London Railway, Ord. | 100 | 3 | 3 | 59 — 64 | .. | 4 13 9 |
| Do. Gtd. Assented | 100 | .. | 4 | 83 — 85 | .. | 4 14 0 |
| Do. Pref. | 100 | 4 | 4 | 70 — 75 | .. | 5 6 8 |
| Do. Gtd. Assented | 100 | .. | 4 | 84 — 86 | .. | 4 13 0 |
| Do. Def. | 100 | 2 | .. | 60 — 65 | .. | 3 1 7 |
| Do. Gtd. Assented | 100 | .. | 4 | 82 — 84 | .. | 4 15 2 |
| Do. 4 % Deb. | 100 | 4 | 4 | 97 — 99 | .. | 4 0 10 |
| City & S. London, 5 % Pref., 1891 | 100 | 5 | 5 | 97 — 99 | −1 | 5 1 0 |
| Do. Do. 1896 | 100 | 5 | 5 | 97 — 99 | .. | 5 1 0 |
| Do. Do. 1901 | 100 | 5 | 5 | 95 — 97 | .. | 5 3 1 |
| Do. Do. 1903 | 100 | 5 | 5 | 93 — 95 | .. | 5 5 0 |
| Do. 4 % Deb. | 100 | 4 | 4 | 88 — 90 | .. | 4 9 0 |
| Hastings Trams, 6 % Pref. | 1 | 6 | 6† | ¾ — ⅞ | .. | 8 0 0 |
| Do. 4½ % Deb. | 100 | 4½ | 4½ | 67 — 72 | +1 | 6 5 0 |
| Isle of Thanet Trams, 5 % Pref. | 5 | 2½ | 3 | 2 — 2½ | .. | 6 0 0 |
| Do. 4 % Deb. | 100 | 4 | 4 | 71 — 76 | .. | 5 5 3 |
| Lancashire United, 5 % Deb. | 100 | 5 | 5 | 83 — 85 | +2 | 5 17 8 |
| London and Suburban, Ord. | 1 | .. | .. | ⅛ — ⅜ | .. | .. |
| Do. Do. 5 % Cum. Pref. | 1 | .. | 5† | ⅝ — ¾ | .. | 6 13 4 |
| Do. Do. 4½ % 1st Deb. | 100 | 4½ | 4½ | 80 — 85 | .. | 5 6 0 |
| London Elec. Railways, 4 % Deb. | 100 | 4 | 4 | 89 — 91 | .. | 4 7 11 |
| London United Trams, 4 % Deb. | 100 | 4 | 4 | 63 — 67 | −1½ | 5 19 5 |
| Metropolitan Railway Consol. | 100 | 1⅝ | 1⅝† | 44½ — 45½ | — ½ | 3 11 10 |
| Do. Surplus Lands | 100 | 2½ | 2½† | 64 — 66 | .. | 4 3 4 |
| Do. 3½ % Deb. | 100 | 3½ | 3½ | 86 — 88 | .. | 3 19 7 |
| Do. 3½ % Pref. | 100 | 3½ | 3½ | 84 — 86 | .. | 4 3 4 |
| Do. 3½ % Con. Pref. | 100 | 3½ | 3½ | 82 — 84 | .. | 4 4 4 |
| Metropolitan District Ord. | 100 | Nil | .. | 32¼ — 32⅝ | — ¼ | Nil |
| Do. 6 % Deb. | 100 | 6 | 6 | 138 — 141 | .. | 4 5 1 |
| Do. 4 % Deb. | 100 | 4 | 4 | 93 — 95 | .. | 4 4 3 |
| Do. 4 % Prior Lien | 100 | 4 | 4 | 97 — 99 | +1 | 4 0 10 |
| Do. 4½ % First Pref. | 100 | 4½ | 4½ | 89 — 91 | .. | 4 19 0 |
| Do. 3½ % Gtd. | 100 | 3½ | 3½ | 75 — 77 | .. | 4 11 1 |
| Metro. Elec. Trams, 4½ % Deb. | 100 | 4½ | 4½ | 92 — 95 | +2 | 4 14 9 |
| Do. 5 % Deb. | 100 | 5 | 5 | 90 — 93 | +1 | 5 7 6 |
| Potteries, Ord. | 1 | 3½ | .. | ⅜ — ½ | .. | .. |
| Do. 5 % Pref. | 1 | 5 | 5 | ⅓ — ⅜ xd | .. | 7 12 8 |
| Do. 4½ % Deb. | 100 | 4½ | 4½ | 84 — 87 | .. | 5 3 6 |
| South Metro. Trams, 6 % Pref. | 1 | 6 | 6† | ⅜ — ½ | .. | 8 0 0 |
| Do. 4 % Deb. | 100 | 4 | 4 | 66 — 70 | .. | 5 14 4 |
| Underground Elec. Railways | 10 | .. | .. | 3⅛ — 3⅜ | .. | Nil |
| Do. "A" | 1/- | .. | .. | 1/32 — 1/16 | — 1/32 | Nil |
| Do. 6 % First Cum. Inc. Deb. | 100 | 6 | 6 | 116 —118 | .. | 5 1 7 |
| Do. 4½ % Bonds | 100 | 4½ | 4½ | 100 —102 | .. | 4 8 0 |
| Do. 6 % Income | 100 | 6 | 6 | 95 — 96 | .. | 6 5 0 |
| Yorkshire (West Riding), Ord. | 5 | Nil | .. | ⅝ — ¾ | .. | Nil |
| Do. 6 % Pref. | 5 | 3 | 4 | 3⅞ — 4⅛ | .. | 4 14 3 |
| Do. 4½ % Deb. | 100 | 4½ | 4½ | 80 — 85 | .. | 5 6 0 |

## ELECTRIC RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

| | | | | | | |
|---|---|---|---|---|---|---|
| Anglo-Arg. Trams, 1st Pref. | 5 | 5½ | 5½ | 4⅞ — 5⅛ | .. | 5 7 5 |
| Do. 2nd Pref. | 5 | 5½ | 5½ | 4⅜ — 4⅝ | .. | 5 19 0 |
| Do. 4 % Deb. | 100 | 4 | 4 | 92½ — 94½ | — ½ | 4 4 8 |
| Do. 4½ % Deb. | 100 | 4½ | 4½ | 90½ — 92½ | .. | 4 11 5 |
| Do 5 % Deb. | 100 | 5 | 5 | 96½ — 98½ | .. | 5 1 6 |
| Auckland Trams, 5 % Deb. | 100 | 5 | 5 | 103 —106 | .. | 4 14 8 |
| Bombay Elec. S. & Trams, Pref. | 10 | 6 | 6 | 10⅞ — 11⅛ | .. | 5 4 4 |
| Do. 4½ % Deb. | 100 | 4½ | 4½ | 94¼ — 96¼ | .. | 4 13 8 |
| Do. 5 % 2nd Deb. | 100 | 5 | 5 | 98 —100 | .. | 5 0 0 |
| Brazilian Traction, Light and Power | $100 | 6 | 6† | 91 — 93 | — ½ | 6 9 0 |
| Brisbane Trams Invt., Ord. | 5 | 8 | 8 | 7⅝ — 8⅛ | .. | 4 18 6 |
| Do. 5 % Pref. | 5 | 5 | 5 | 4⅝ — 4⅞ | .. | 4 13 0 |
| Do. 4½ % Deb. | 100 | 4½ | 4½ | 99 —102 | +2 | 4 8 3 |
| B. Columbia Elec. Rly., Def. | 100 | 8 | 8† | 121 —125 | +1 | 6 8 4 |
| Do. Pref. Ord. | 100 | 6 | 6 | 107 —111 | .. | 5 8 1 |
| Do. 5 % Pref. | 100 | 5 | 5 | 103½ —106½ | +1 | 4 13 0 |
| Do. 4½ % 1st Mort. Deb. | 40 | 4½ | 4½ | 98 —101 | .. | 4 9 1 |
| Do. 4½ % Vancouver Deb. | 100 | 4½ | 4½ | 94 — 98 | .. | 4 12 0 |
| Do. 4½ % Con. Deb. | 100 | 4½ | 4½ | 96 — 98 | .. | 4 6 9 |
| Calcutta Trams, Ord. | 5 | 7½ | 5† | 6 — 6¼ | .. | 5 15 5 |
| Do. 5 % Pref. | 5 | 5 | 5 | 5 — 5¼ | .. | 4 15 3 |
| Do. 4½ % Deb. | 100 | 4½ | 4½ | 96 — 99 | .. | 4 11 0 |
| Cape Electric Trams | 1 | 5 | 5 | ⅝ — ¾ | .. | 6 13 4 |
| City Buenos Aires Trams (1904) | 5 | 5† | 5 | 5⅜ — 5⅝ | −1/16 | 4 9 0 |
| Do. 4 % Deb. | 100 | 4 | 4 | 91 — 96 | .. | 4 3 4 |
| Colombo Elec. Tr. & Lt., 5 % Deb. | 100 | 5 | 5 | 89 — 93 | .. | 5 7 8 |
| Havana Elec. Rly., 5 % Bonds | $1000 | 5 | 5 | 93½ — 97½ | .. | 5 2 6 |
| Kalgoorlie Elec. Trams | 1 | Nil | .. | 0 — 1/16 | .. | Nil |
| Do. 5% A Deb. | 100 | 5 | 5 | 85 — 90 | .. | 5 11 1 |
| Do. 6 % B Deb. | 100 | 3 | .. | 10 — 20 | .. | Nil |
| La Plata Elec. Trams, Ord. | 1 | .. | .. | 3/32 — 1/8 | .. | .. |
| Do. Pref. | 1 | 4½d. | 6 | 1/16 — 1/8 | .. | 6 0 0 |
| Lisbon Elec. Trams, Ord. | 1 | 6 | 6† | 1⅛ — 1⅜ | .. | 4 7 8 |
| Do. 6 % Pref. | 1 | 6 | 6 | 1⅛ — 1⅜ | .. | 5 1 0 |
| Do. 5 % Deb. | 100 | 5 | 5 | 91 — 96 | .. | 5 4 2 |
| Madras Elec. Tr., 6 % Cum. Pref. | 5 | 6 | 6 | 5 — 5⅜ | + ⅛ | 5 11 7 |
| „ Elec. Tr. (1904), Deb. | 100 | 5 | 5 | 101 —103 | .. | 4 17 0 |
| Manaos Trams & Lt., 1st Deb. | 100 | 5 | 5 | 79 — 82 | .. | 6 2 0 |
| Manila Elec. R. and Ltg., Bonds | $1000 | 5 | 5 | 98 —100 xd | +1 | 5 0 0 |
| Mexico Trams Con | $100 | 7 | 7 | 70 — 74 | −3½ | .. |
| Do. Gen. Con. 5 % Bonds | .. | 5 | 5 | 78 — 83 | −4 | 6 0 6 |
| Do. 6 % Bonds | 100 | 6 | 6 | 83 — 87 | .. | 6 18 0 |
| Para Elec. Rlys. & Lt., Ord. | 5 | 10 | 10† | 4⅞ — 5⅛ | — ⅛ | 9 6 0 |
| Do. 6 % Pref. | 5 | 6 | 6 | 4⅝ — 5 | .. | 6 0 0 |
| Do. 5 % 1st Deb. | 100 | 5 | 5 | 93 — 95 | — ½ | 5 5 3 |
| Rangoon El. Tr. & Sup., Pref. | 5 | 6 | 6 | 5 — 5⅛ | .. | 5 9 1 |
| Do. 4½ % 1st Deb. | 100 | 4½ | 4½ | 95 — 97 | .. | 4 12 9 |
| Rio de Janeiro Trams, 1st Mort. & 5 % Bonds | .. | 5 | 5 | 101 —103 | .. | 4 17 0 |
| Do. 5 % Mort. Bonds | 100 | 5 | 5 | 94 — 96 | — ½ | 5 4 2 |
| Sao Paulo Tram., Lt. and P. & 5 % 1st Deb. | $500 | 5 | 5 | 100 —103 | .. | 4 17 0 |
| Singapore Trams, 5 % Deb. | 100 | 5 | 5 | 87 — 91 | .. | 5 10 1 |
| Southern El. Tr. B.A., 5 % Deb. | 100 | 5 | 5 | 97 — 99 | −1 | 5 1 0 |
| Un. Elec. Trams Monte Video | 5 | 7 | 7 | 4⅜ — 5⅛ | .. | 6 16 7 |
| Do. 6 % Pref. | 5 | 6 | 6 | 4⅛ — 5⅛ | .. | 5 14 3 |
| Do. 5 % 1st Deb. | 100 | 5 | 5 | 94 — 97 | .. | 5 3 0 |
| Winnipeg Elec. Rly., 4½ % Deb. | 100 | 4½ | 4½ | 95 — 97 | .. | 4 12 9 |

## ELECTRICITY SUPPLY AND POWER COMPANIES.—HOME.

| | | | | | | |
|---|---|---|---|---|---|---|
| Bournemouth & Poole, Ord. | 10 | 6 | 5† | 9 — 10 | .. | 6 0 0 |
| Do. 4½ % Pref. | 10 | 4½ | 4½ | 8⅝ — 9⅛ | — ⅛ | 4 14 9 |
| Do. Second 6 % Pref. | 10 | 6 | 6 | 9⅞ — 10⅛ | .. | 5 11 7 |
| Do. 4½ % Deb. Stock | Stock | 4½ | 4½ | 93 — 96 | .. | 4 13 9 |
| Brompton & Kensington, Ord. | 5 | 10 | 9† | 9¼ — 9⅝ | .. | 5 4 0 |
| Do. 7 % Cum. Pref. | 5 | 7 | 7 | 8⅝ — 9⅛ | .. | 3 16 9 |
| Central Electric Supply, 4 % Guar. Deb. | 100 | 4 | 4 | 90 — 93 | .. | 4 6 0 |
| Charing Cross, West End & City | 5 | 5 | 6† | 4⅜ — 5⅛ | + ⅛ | 5 14 3 |
| Do. 4½ % Cum. Pref. | 5 | 4½ | 4½ | 4⅜ — 4¾ xd | + ⅛ | 4 12 4 |
| Do. "City Undertaking" 4½ % Cum. Pref. | 5 | 4½ | 4½ | 4 — 4½ | .. | 5 0 0 |
| Do. Do. 4 % Deb. | 100 | 4 | 4 | 92 — 94 | +1½ | 4 5 1 |
| Chelsea, Ord. | 5 | 5 | 4† | 4⅞ — 5⅜ | — ⅛ | 4 13 0 |
| Do. 4½ % Deb. | Stock | 4½ | 4½ | 97 — 100 | .. | 4 10 0 |
| City of London, Ord. | 10 | 9 | 10† | 18 — 19 | — ½ | 5 5 3 |
| Do. 6 % Cum. Pref. | 10 | 6 | 6 | 13 — 14 | .. | 4 5 9 |
| Do. 5 % Deb. | Stock | 5 | 5 | 116 —120 | .. | 4 3 4 |
| Do 4½ % Second Deb. | 100 | 4½ | 4½ | 99 —102 | .. | 4 8 1 |
| County of London, Ord. | 10 | 6 | 5† | 12⅜ — 13⅝ | .. | 4 11 5 |
| Do. 6 % Pref. | 10 | 6 | 6 | 11⅝ — 12½ | — ⅛ | 4 18 0 |
| Do. 4½ % Deb. | Stock | 4½ | 4½ | 101⅛ —103½ | .. | 4 7 0 |
| Do. 4½ % Second Deb. | Stock | 4½ | 4½ | 99 —102 | .. | 4 8 1 |
| Edmundson's, Ord. | £3 | .. | .. | ⅜ — ⅝ | .. | Nil |
| Do. 6 % Cum. Pref. | 5 | 6 | 6 | 3⅞ — 4⅛ | .. | 7 5 5 |
| Do. 6 % Non-Cum. Pref. | 5 | .. | .. | 1⅝ — 2 | .. | .. |
| Do. 4½ % First Mort. Deb. | 100 | 4½ | 4½ | 84 — 87 | .. | 5 3 6 |
| Folkestone | 5 | 6 | 6 | 4½ — 5 | .. | 6 0 0 |
| Do. 5 % Cum. Pref. | 5 | 5 | 5 | 4⅜ — 4⅝ | .. | 5 2 7 |
| Do. 4½ % First Deb. | 100 | 4½ | 4½ | 91 — 93 | +1 | 4 16 9 |
| Hove | 5 | 8 | 8† | 8⅜ — 9½ | .. | 4 17 3 |
| Kensington & Knightsbridge, Ord. | 5 | 8 | 9† | 7¾ — 8¼ | .. | 5 9 1 |
| Do 4 % Deb. | Stock | 4 | 4 | 89 — 91 | .. | 4 8 0 |
| Kent Elec. Power, 4½ % Deb. | Stock | 4½ | 4½ | 76 — 80 | .. | 5 12 0 |
| London Electric, Ord. | 3 | 2½ | .. | 1⅜ — 1½ | .. | 4 5 0 |
| Do. 6 % Pref. | 5 | 6 | 6 | 5 — 5⅜ | — ⅛ | 5 11 7 |
| Do. 4 % First Mort. Deb. | Stock | 4 | 4 | 90 — 93 | .. | 4 6 3 |
| Metropolitan | 5 | 4 | 4† | 3⅝ — 4⅛ | .. | 4 17 0 |
| Do. 4½ % Cum. Pref. | 5 | 4½ | 4½ | 4⅜ — 5 | + ⅛ | 4 10 0 |
| Do. 4½ % First Mort. Deb. | Stock | 4½ | 4½ | 97 —100 | .. | 4 10 0 |
| Do. 3½ % Mort Deb. | Stock | 3½ | 3½ | 82 — 85 | .. | 4 2 4 |
| North Metropolitan Power Supply, 5 % Mortgages (Red.) | 100 | 5 | 5 | 100 —103 | .. | 4 17 1 |
| Notting Hill, 6 % Non-Cum. Pref. | 10 | 6 | 6 | 9⅜ — 10⅛ | .. | 5 14 3 |
| Oxford | 5 | 7 | 6† | 6 — 6¼ | .. | 5 7 8 |
| St. James' and Pall Mall, Ord. | 5 | 10 | 12† | 9⅜ — 10⅛ | .. | 5 18 5 |
| Do. 7 % Pref | 5 | 7 | 7 | 6⅞ — 7⅛ | .. | 4 18 3 |
| Do. 3½ % Deb. | 100 | 3½ | 3½ | 82 — 85 | .. | 4 2 4 |
| South London, Ord. | 4 | 5½ | .. | 8¼ — 8⅝ | .. | 6 1 9 |
| Do. 5 % First Mort. Deb. | 100 | 5 | 5 | 98 —101 | .. | 4 19 0 |
| South Metropolitan, 7 % Pref. | 1 | 7 | 7 | 1⅞ — 1 7/32 | .. | 5 14 9 |
| Do. 4½ % First Deb. Stock | 100 | 4½ | 4½ | 93 — 96 | .. | 4 13 9 |
| Urban, Ord. | £3 | Nil | .. | ⅜ — ½ | .. | .. |
| Do. 5 % Cum Pref. | 5 | 3‡ | .. | 2⅝ — 3⅛ | + ⅛ | 4 18 0 |
| Do. 4½ % First Mort. Deb. | 100 | 4½ | 4½ | 86 — 89 | .. | 5 1 3 |
| Westminster, Ord. | 5 | 10 | 10 | 9 — 9½ | .. | 5 5 3 |
| Do. 4½ % Cum Pref. | 5 | 4½ | 4½ | 5 1/16 — 5 3/16 | .. | 4 4 8 |

* Unless otherwise stated, all shares are fully paid. † Interim Dividend. ‡ 8s. Cash and 2% in Funded Certs.

*Continued on next page.*

# SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

## ELECTRICITY SUPPLY AND POWER—COLONIAL AND FOREIGN.

| NAME. | Stock or Share. | Dividends for | | Closing Quotations Feb. 17th. | Rise + or Fall — | Present Yield p.c. |
|---|---|---|---|---|---|---|
| Adelaide, 6 % Pref. | £ | 6 | 6† | 5⅛ — 5⅜ | .. | 5 11 7 |
| Calcutta, Ord. | £ | 8½ | 6† | 7⅞ — 8 | .. | 5 6 3 |
| Do. 6 % Pref. | £ | 6 | 6 | 5⅞ — 6⅛ | .. | 4 14 1 |
| Calgary Power, 1st Mort. Bds. | 100 | 5 | 5 | 89 — 91 | — ½ | 5 10 0 |
| Canadian Gen. El. Com. | $100 | 7 | 8 | 113 —117 | .. | 6 16 7 |
| Do. 7 % Pref. | $100 | 7 | 7 | 123 —128 | +1 | 5 9 5 |
| Cordoba Lt., Power and T., Ord. | £ | 5 | .. | ⅞ — ⅝ | .. | 7 12 0 |
| Do. 5 % Deb. | 100 | 5 | 5 | 90 — 93 | .. | 5 7 6 |
| Elec. Lt. and P. of Cochabamba, 6 % Bonds | 100 | 6 | 6 | 87½ — 89½ | .. | 6 14 1 |
| Elec. Supply Victoria, 5 % 1st Mort. Deb. | 100 | 5 | 5 | 91 — 94 | .. | 5 6 5 |
| Elec. Dev. Ontario, 5 % 1st Mort. Bonds | $500 | 5 | 5 | 96 — 98 | .. | 5 2 0 |
| Kalgoorlie Elec. P. and L., Ord. | 10/- | Nil | .. | ⅜ — ⅝ | .. | Nil |
| Do. 6 % Pref. | £ | 6 | 6† | ⅝ — ¾ | .. | 11 5 8 |
| Kaministiquia Power, 5 % G. Bs. | $500 | 5 | 5 | 102 —104 | .. | 4 16 2 |
| Madras, Ord. | £ | Nil | .. | 1¼ — 1⅜ | .. | .. |
| Melbourne, 5 % 1st Mort. Deb. | 100 | 5 | 5 | 103 —106 | +2 | 4 14 4 |
| Mexican El. Lt., 5 % 1st M. Bds. | .. | 5 | 5 | 64 — 69 | —1 | 7 5 0 |
| Mexican Lt. & Power, Common | $100 | 4 | 4† | 43 — 46 | —1 | .. |
| Do. 7 % Cum. Pref. | $100 | 7 | 7 | 83 — 87 | .. | 8 1 0 |
| Do. 5 % 1st Mort. Gold Bds. | .. | 5 | 5 | 79 — 83 | .. | 6 0 6 |
| Do. 5 % 2nd Mort. Bonds | 100 | 5 | 5 | 64 — 68 | .. | 7 7 1 |
| Monterey Rly., Light & Power, 5 % 1st Mort. Deb. | * | 1919. | 1913. | | | £ s. d. |
| | 100 | 5 | 5 | £6 — 61 | —8 | .. |
| Montreal, Lt., H. and Power | $100 | 9 | 10† | 228 — 233 | .. | 4 5 10 |
| Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds | $500 | 5a | 5a | 10 — 20 | .. | .. |
| River Plate, Ord. | Stock | 10 | .. | 207 —217 | .. | 4 8 0 |
| Do. 6 % Non-Cum. Pref. | Do. | 6 | 6 | 103 —108 | .. | 5 11 1 |
| Do. 5 % Deb. Stock | Do. | 5 | 5 | 101 —103 | .. | 4 17 0 |
| Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb. | 100 | 4½ | 4½ | 102 —104 | .. | 4 6 7 |
| Shawinigan Water, Capital | $100 | 5½ | 6† | 144 —148 | +1 | 4 1 1 |
| Do. 5 % Con. 1st Mort. Bonds | $500 | 5 | 5 | 106 —108 | +1½ | 4 12 7 |
| Do. 4½ % Per. Deb. | Stock | 4½ | 4½ | 98 —101 | .. | 4 9 0 |
| Toronto Power, 4½ % Deb. | Do. | 4½ | 4½ | 95 — 98 | .. | 4 11 10 |
| Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb. | 100 | 5 | 5 | 88 — 90 | .. | 5 11 1 |
| Victoria Falls Power, Pref. | 1 | 6 | 6 | ⅜ — ⅝ | —1/32 | 7 7 8 |
| West Kootenay Power and Lt., 1st Mort. 6 % Gold | 100 | 6 | 6 | 108 —106 | .. | 5 14 8 |

## MANUFACTURING COMPANIES.

| | | | | | | |
|---|---|---|---|---|---|---|
| Aron, Ord. | £ | 7 | .. | 1⅛ — 1⅜ | .. | 8 12 4 |
| Do. 6 % Pref. | £ | 6 | 6 | ⅜ — ⅝ | .. | 6 17 2 |
| Babcock & Wilcox | £ | 16 | 14† | 3⅜ — 3½ | +⅛ | 5 18 6 |
| Do. Pref. | £ | 6 | 6 | 1⅝ — 1⅞ | .. | 4 8 6 |
| British Aluminium, Ord. | £ | .. | .. | 1⅛ — 1⅜ | .. | .. |
| Do. 6 % Cum. Pref. | £ | 6 | 6 | ⅞ — 1 | .. | 6 8 0 |
| Do. 5 % Prior Liens Debs. | 100 | 5 | 5 | 96 — 99 | +1 | 5 1 0 |
| Do. Deb. Stk. | 100 | 5 | 5 | 90 — 95 | +4 | 5 5 3 |
| B.I. & Helsby Cables | £ | 10 | 8† | 8⅞ — 9⅛ | .. | 5 6 8 |
| Do. Pref. | £ | 6 | 6 | 5⅝ — 6⅛ | .. | 4 14 1 |
| Do. Deb. | 100 | 4½ | 4½ | 102 —105 | .. | 4 5 9 |
| British Thomson-Houston, Deb. | 100 | 4½ | 4½ | 92 — 95 | .. | 4 14 9 |
| British Westinghouse, Pref. | £ | Nil | .. | 1⅜ — 1⅞ | .. | Nil |
| Do. Deb. | 100 | 4 | 4 | 68 — 71 | .. | 5 12 8 |
| Do. 6 % Prior Lien | 100 | 6 | 6 | 102 —105 | .. | 5 14 6 |
| Browett, Lindley, Ord. | £ | .. | .. | 2/- —3/- | .. | Nil |
| Do. Pref. | £ | .. | .. | 8/- —8/6 | .. | Nil |
| Brush, 7 % Pref. | £ | Nil | .. | 0 — ¼ | .. | Nil |
| Do. 5 % Prior Lien Deb. | 100 | 5 | 5 | 80 — 85 | .. | 5 17 8 |
| Lo 4½ % Deb. | 100 | 4½ | 4½ | 39 — 43 | .. | 10 9 4 |
| Do. 4½ % Second Deb. | 100 | 4½ | 4½ | 28 — 27 | .. | 16 13 4 |
| Callender's Cable | £ | 15 | 6† | 11⅜ — 12½ | + ½ | 6 2 4 |
| Do. Pref. | £ | 5 | 5 | 4⅞ — 5⅛ | .. | 4 17 9 |
| Do. Deb. | 100 | 4½ | 4½ | 97 —100 | .. | 4 10 0 |
| Castner-Kellner | £ | 20 | 22½ | 23 — 27 | + ⅛ | .. |
| Do. Deb. | 100 | 4½ | 4½ | 103 —106 | .. | 4 5 1 |
| Crompton & Co., Deb. | 100 | 5 | 5 | 83 — 85 | +1 | 5 17 8 |
| Dick, Kerr | £ | Nil | .. | ⅛ — ⅜ | .. | .. |
| Do. Pref. | £ | 6 | 6 | ⅝ — ⅞ | .. | 7 2 2 |
| Edison & Swan, A, £2 paid | £ | Nil | .. | ¾ — ⅞ | +1/32 | Nil |
| Do. fully paid | £ | Nil | .. | 1 — 1⅛ | .. | Nil |
| Do. 4 % Deb. | 100 | 4 | 4 | 58 — 62 | .. | 6 9 1 |
| Do. 5 % Second Deb. | 100 | 5 | 5 | 63 — 68 | .. | 7 7 1 |
| Electric Construction | £ | 5 | .. | ⅜ — ⅝ | .. | 7 5 6 |
| Do. Pref. | £ | 7 | 7 | 1⅛ — 1⅜ | .. | 6 11 7 |
| Greenwood & Batley, Pref. | £ | 7 | 7 | 6½ — 7¼ | .. | 9 13 2 |
| Do. Deb. | 100 | 5 | 5 | 92 — 94 | .. | 5 6 5 |
| General Electric, 6 % Pref. | £ | 6 | 6 | 10½ — 10⅝ | .. | 5 14 3 |
| Do. Deb. | 100 | 4 | 4 | 88 — 93 | .. | 4 6 0 |
| Henley's, Ord. | £ | 15 | 20† | 14 — 15 | + ⅛ | 6 13 4 |
| Do. Pref. | £ | 4½ | 4½ | 4⅞ — 5⅛ | + 1/16 | 4 7 10 |
| Do. Deb. | 100 | 4½ | 4½ | 101 —103 | +1 | 4 7 5 |
| India-Rubber, G. & T. | £ | 10 | 7½ | 11 — 12 | .. | 6 5 0 |
| Do. Pref. | £ | 10 | 5 | 9 — 9⅜ | .. | 5 2 7 |
| Telegraph Construction | £ | 12 | 20 | 39 — 41 | +1 | 5 17 0 |
| Do. Deb. | 100 | 4 | 4 | 98 —100 | +1 | 4 0 0 |
| Willans & Robinson, 4 % 1st Mort. Deb. | 100 | 4 | 4 | 65 — 69 | .. | 5 16 0 |
| Do. B 4 % Cum. Pref. | 100 | .. | .. | 51 — 56 | .. | .. |

## TELEGRAPH AND TELEPHONE COMPANIES.

| | | | | | | |
|---|---|---|---|---|---|---|
| Amazon Telegraph | £ | 4½ | 4½ | 6⅛ — 6⅜ | .. | 6 18 4 |
| Do. 6 % Deb. Red. | Stock | 5 | 5 | 94 — 97 | .. | 5 3 0 |
| American Telep. & Teleg., Cap. | $100 | 8 | 8 | 122 —126 | —1 | 6 7 0 |
| Do. Collat. Trust | $1000 | 4 | 4 | 92 — 95 | +1 | 4 4 3 |
| Anglo-American Telegraph | Stock | 3 | 3 | 65 — 68 | .. | 4 8 3 |
| Do. 6 % Pref. | Do. | 6 | 6 | 103½—109½ | .. | 5 9 4 |
| Do. Def. | Do. | 30/- | .. | 24⅜ — 24⅝ | — ⅛ | 6 0 7 |
| Anglo-Portuguese Tel., 5 % Mort. Deb. | 100 | 5 | 5 | 103 —105 | .. | 4 15 2 |
| Chili Telephone | £ | 8 | .. | 7⅜ — 7⅝ | .. | 5 5 0 |
| Commercial Cable, Stlg. 4 % Deb. | Stock | 4 | 4 | 81½ — 83½ | + ½ | 4 16 0 |
| Cuba Telegraph | £ | 10 | 6† | 8⅛ — 9⅜ | .. | 6 8 1 |
| Do. 10 % Pref. | £ | 10 | 10 | 15½ — 16⅜ | .. | 5 19 5 |
| Direct Spanish Telegraph, Ord. | £ | 4 | 4 | 3⅞ — 4 | .. | 5 0 0 |
| Do. 10 % Cum. Pref. | £ | 10 | .. | 7⅞ — 8 | .. | 6 5 0 |
| Direct United States Cable | £ | 4 | 4† | 6⅞ — 7⅜ | .. | 5 8 6 |
| Direct W. India Cable, 4½ % Reg. Deb. | 100 | 4½ | 4½ | 97 — 99 | .. | 4 10 10 |
| Eastern Telegraph, Ord. Stock | Stock | 7 | 7 | 134 —137 | +1 | 5 3 0 |
| Do. 8½ % Pref. Stock | Do. | 8½ | 8½ | 78 — 80 | .. | 4 7 6 |
| Do. 4 % Mort. Deb. | Do. | 4 | 4 | 95 — 97 | .. | 4 2 4 |
| Eastern Extension | £ | 10 | 7 | 12⅜ — 12⅝ | — ⅛ | 5 8 9 |
| Do. 4 % Deb. | Stock | 4 | 4 | 94 — 96 | .. | 4 3 4 |
| Globe Telegraph and Trust | £ | 10 | 6† | 11⅜ — 11⅞ | + ⅛ | 5 1 1 |
| Do. 6 % Pref. | £ | 10 | 6 | 12½ — 13 | .. | 4 12 4 |
| Great Northern Telegraph | £ | 10 | 20 | 31½ — 34½ | +1 | 5 16 0 |
| Indo-European Telegraph | £ | 25 | 18 | 58 — 60 | .. | 5 8 4 |
| Mackay Companies Common | £ | 100 | 5 | 83 — 87 | .. | 5 15 0 |
| Do. 4 % Cum. Pref. | £ | 100 | 4 | 67 — 71 | .. | 5 12 8 |
| Marconi's Wireless Telegraph | £ | 1 | 20 | 20 | 32⅜ — 33⅞ | —1/16 | 5 3 1 |
| Do. 7 % Cum. Partic. Pref. | £ | 1 | 17 | .. | 3⅛ — 3⅜ | .. | 5 0 9 |
| Monte Video Telephone, Ord. | £ | 1 | 6 | 6 | 1/16 — 1/8 | .. | 6 8 0 |
| Do. 5 % Pref. | £ | 1 | 5 | 5 | 1/8 — 3/16 | .. | 5 14 3 |
| New York Telep., 4½% Gen. Bnds. | 100 | 4½ | 4½ | 100 —101 | .. | 4 9 0 |
| Oriental Telep. and Elec. | £ | 1 | 10 | 10† | 1⅞ — 2⅛ | .. | 4 14 0 |
| Do. 6 % Cum. Pref. | £ | 1 | 6 | 6 | 1⅛ — 1⅜ | .. | 4 16 0 |
| Do. 4 % Red. Deb. | Stock | 4 | 4 | 87½ — 89½ | + ½ | 4 9 5 |
| Pacific and European Tel., 4 % Guar. Debs. | Do. | 4 | 4 | 98 —100 | .. | 4 0 0 |
| Reuter's | £ | 10 | 10 | 10† | 9 — 10 | .. | 10 0 0 |
| Submarine Cables Trust | £ | Cert. | 6 | 6 | 126 —129 | +2 | 4 13 0 |
| Telephone Co. of Egypt, 4½ % Deb. Red. | Stock | 4½ | 4½ | 96½ — 98½ | + ½ | 4 11 5 |
| United River Plate Telephone | £ | 8 | 6† | 6⅝ — 6⅞ | — ⅛ | 5 16 5 |
| Do. 5 % Cum. Pref. | £ | 5 | 5 | 5⅛ — 5⅜ | .. | 4 9 0 |
| West Coast of America | £ | 2½ | 2½ | .. | 1⅞ — 1⅞ | .. | 4 8 0 |
| Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel. | 100 | 4 | 4 | 96 — 99 | .. | 4 0 10 |
| West India and Panama Teleg. | £ | 10 | 1½ | 1½ | 2⅜ — 2⅝ | —1/16 | 4 8 6 |
| Do. 6 % Cum. 1st Pref. | £ | 10 | 6 | 6 | 9⅜ — 10⅛ | .. | 5 17 0 |
| Do. 6 % Cum. 2nd Pref. | £ | 10 | 6 | 6 | 9 — 9½ | .. | 6 6 4 |
| Do. 5 % Debs. | 100 | 5 | 5 | 97 — 99 | .. | 5 1 0 |
| Western Telegraph, Ltd. | £ | 10 | 7† | 7 | 13⅛ — 13⅜ | .. | 5 2 8 |
| Do. 4 % Debs. | Stock | 4 | 4 | 95 — 97 | .. | 4 2 8 |
| Western Union 4½ % Fdg. Bonds | $1000 | 4½ | 4½ | 96 — 98 | .. | 4 11 1 |

* Unless otherwise stated all shares are fully paid. † Interim dividend. *a* Paid in deferred interest warrants.

Bank rate of Discount 3 per cent., January 29th, 1914.

**The Metric System.**—The Decimal Association has sent us a copy of its report for the year 1913, together with a price list of its publications, and a verbatim report of an address by Mr. Alexander Siemens to the Bradford Textile Society on November 17th last year. The report for the year refers to the adoption of the metric carat by Order in Council, the steps taken to forward the movement in Australia and India, the adoption of the metric system by Siam and in Tripoli, the favourable attitude of the Japanese Government, and the inquiry in progress by order of the Chinese Government into the question of introducing the system into China. Captain H. Riall Sankey and Mr. Hugo Hirst have been elected to the Executive Committee, and Sir Charles Parsons has joined the Association. The populations of the countries which have adopted the metric weights and measures as their sole standards now amount to 476 millions, including Siam.

Mr. Siemens's address was given on the invitation of the Bradford Textile Society; it covered briefly the history of the system and the arguments in favour of its adoption by this country. A discussion followed, in which almost all of the speakers favoured the metric system, and a resolution was carried, with only four dissentients, to the effect that the meeting viewed with favour the compulsory adoption of the metric weights and measures in this country, and urged the Bradford Textile Society and other trade organisations to work for the reform. Only two members of the Textile Society voted against the proposal, which is often said to be hopeless of adoption in the textile industries.

## NOTES ON THE STARTING OF SQUIRREL-CAGE MOTORS.

By E. JACKSON.

The reliability and simplicity of the squirrel cage motor render its adoption particularly desirable in many cases where these factors are of vital importance and where the nature of the load is such that no speed variation is required.

Having such an extremely simple piece of apparatus as the squirrel-cage motor, it is very advisable to give due consideration to the starting arrangement, which should be equally reliable, if properly selected, as the motor it controls. Generally speaking, starting may be performed in five ways, viz.:—

1.—By using a plain triple-pole switch, either single or double throw, arranged to throw the motor direct across the lines.

2.—Employing an auto-starter enabling a definite percentage of line volts to be first applied—full voltage being thrown on when the motor has started.

3.—Star-Delta starting—the motor having its winding connected in star at starting, and the alteration to delta being made when the motor is more or less up to speed.

4.—By inserting resistance in series with the stator windings during starting, this resistance being entirely cut out in the full speed and running position.

5.—Where a group of motors, all driven by one generator, are required to start up together, all the motors may be connected to the generator, and the latter gradually run up to speed—the speed of the motors gradually increasing with the speed of the generator.

At the outset it must be clearly understood that all the above methods, with the exception of (1), have one object, viz., to reduce the voltage applied to the motor windings at starting, thus reducing the rush of current, torque, and disturbance to the system which would result from the motor being thrown across the lines.

The curves shown in Fig. 1 will be found of use, whatever system is employed, graphically showing

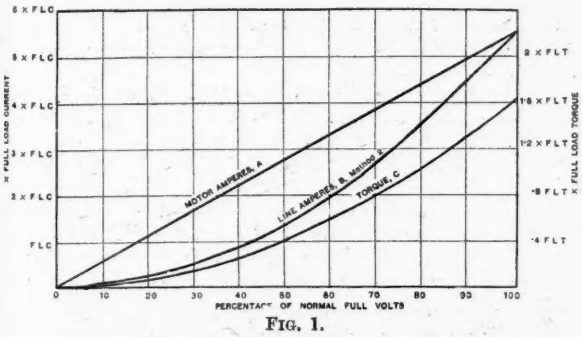



Fig. 1.

the relation between the percentage starting voltage applied and the resultant torque and current. They have been calculated for a well-known make of motor, and although individual makes of machines may vary somewhat more or less, they will be found to be sufficiently representative for most practical purposes.

1. *Direct Starting.*—It is at once obvious from the curve that this method must be limited to comparatively small machines, since the momentary rush of current at starting may reach 5½ times normal full load. It will be found, therefore, that 15 H.P. represents the usual limit, although for individual cases where the starting is light and the momentary heavy rush of current no disadvantage, motors of large horse-power may be successfully started in this way. The L.E.P. Co. state that motors up to 15 H.P. may be switched straight on to the mains, provided they are started up absolutely light; if they are started up under load, 7½ H.P. is the limit which may be switched straight on.

It is advisable that the starting switch be of the double-throw type, and so arranged that ammeter, fuses, and other protective devices are cut out at starting, otherwise the instrument may be damaged by the heavy rush of current, while if the fuses are not to blow they must be rated so high as to be of little use. Of course, a time-limit device on the circuit breaker is an alternative to the above. Owing to the heavy momentary currents it is advisable that all contacts on the starting switches be readily and cheaply renewable. Either oil immersed or non-oil immersed switches are permissible, the type largely depending on the situation in which the starter is used. In either case it is advisable to select a switch designed with the object of starting motors by this method rather than a cheap, flimsy article which is merely a three-pole switch but nothing more.

2. *Auto-Transformer Starting.*—The auto-transformer starter is perhaps the most widely used, and is a piece of apparatus standardized from the lowest horse-power up to 500 or 600 H.P. This type of starter may either have a single starting position, or, alternatively, may gradually increase the applied voltage by several steps. Generally speaking, the first-mentioned type is the more usual and meets most requirements.

The change-over, or switch, portion of the starter generally is either of the knife switch or drum type, the fixed contacts being connected to a, preferably, self-contained auto-transformer. The auto-transformer may either have two or three windings, the first arrangement having the coils connected in V and resulting in a slightly simplified starter. On moving the handle to the starting position, the auto-transformer coils are connected directly across the lines, while the windings of the motor are connected across a definite percentage of the total turns in the coils, thus applying a definite voltage to the motor, say, only 60 per cent. of normal.

The starting voltage should be the lowest at which the necessary torque to start the motor can be obtained, and to secure this an auto-starter should have provision for readily adjusting the starting voltage on site. It is advisable to specify that starting voltages of, say, 25, 40, 50, 60, or 75 per cent. of line voltage may be obtained. The curve in Fig. 1 is of use in settling which is likely to be the nearest voltage for any particular job where the starting

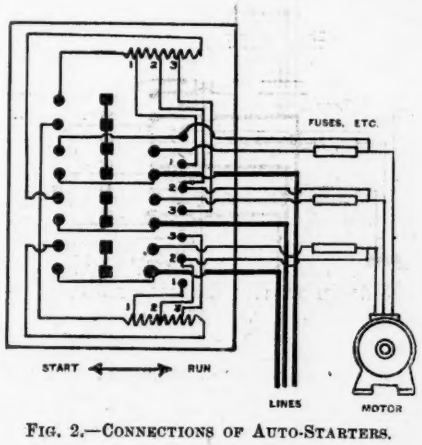



Fig. 2.—Connections of Auto-Starters.

torque is roughly known beforehand. It must be clearly understood that the current given (curve A) is *motor* current, and that therefore the *line* current will be proportionately less dependent on the particular tapping employed (see Curve B). For instance, with a 50 per cent. tapping the line current will only

be about half the motor current, and so on. Here again it may be advisable to cut out fuses, etc., at starting, and Fig. 2 shows the diagram of connections to give this feature, the starter being one of the change-over knife switch type.

Some trouble has been experienced on this type of starter by reason of the fact that it is often possible to leave the starting handle in the "start" position. With a careless attendant, it will be seen that there is a chance of burning out the auto-transformer coils, since naturally these are only rated to carry current for a minute or two without damage. Something in the nature of a spring return is therefore highly desirable, and it will be found that it is now possible to obtain starters of the drum type embodying this feature, although there will always be numerous cases where the simple type, without spring return, may be safely installed. A feature which should be insisted upon is the provision of means to render it necessary for the operator to move the handle into the starting position before it is possible to move it over into the running position, and further that the actual change over be quickly made.

One interlock, using a trigger on the handle engaging on the inner and outer surfaces of a cam on the case, is defective in that although it ensures the operator first moving to the "start," yet in the event of his moving back to the "off," and leaving the handle there, it is now possible on the next attempt to start to move straight over into the running position. Although not recommended, it will be seen that the use of this method of starting permits of torques higher than full load being obtained, provided that a suitable tapping is used.

3. *Star-Delta Starting.*—This is one of the simplest and best methods provided the starting torque does not exceed half normal load. It will be seen that this method is really equivalent to using an auto-starter having a 58 per cent. tapping, since the voltage at starting is $1/1.73 = .58$ of that when running.

It should be noted from the curve B that the current taken is approximately 2 F.L.C. from the line, which is not excessive, and hence quite large motors may safely be started by this method under suitable conditions.

The motor has generally to be wound somewhat specially, but this usually presents no difficulty on motors for circuits not exceeding a medium pressure. The main advantage of this method lies in the simplicity of the starting gear, the auto-trans-

Fig. 3.—Star-Delta Starter, with Ammeter and Trifurcating Box.

former coils used in method (2) being eliminated, together with their possibility of breakdown.

Starters of the star-delta type should be provided with some device to prevent the operator going straight over from the "off" to the "delta" position, and preferably should ensure a definite pause being made in the "star" or starting position, while it is a further advantage to arrange so that the starter will not remain in the starting position, if the starter handle be released. Figures 3 and 4 show a typical star-delta starter embodying the above points.

4. *Resistance Starting.*—The method of introducing resistance into the stator circuit at starting is chiefly employed on small machines starting light and where the current increments at starting are to be strictly limited. The usual starting arrangement is of a very similar construction to the ordinary

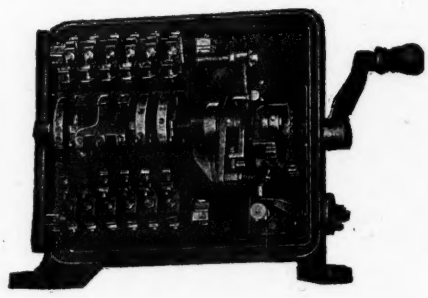


Fig. 4.—Underneath View of Starter, with Oil Tank Removed.

rotor starter, but has the three arms of the starter insulated, one from the other. An alternative arrangement which may be of use in an emergency is shown in Fig. 5, and allows the use of an ordinary type of starter, or even a liquid starter, assuming the pressure does not exceed the limits of medium pressure.

It will be noted that a separate triple-pole switch is necessary to isolate the motor and starter.

Either of these methods of connection may be

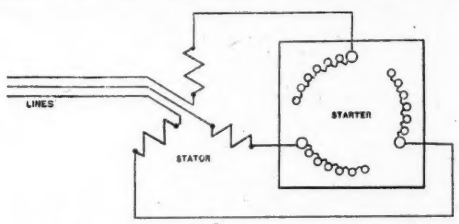



Fig. 5.—Connections of Rheostatic Starter.

used, say, for motors up to about 15 H.P., starting under not more than half full-load torque with about twice full-load current.

5. *Starting with Generator.*—This method obviously can only be used in certain cases, and even then it is usually necessary to provide each motor with a separate starting switch, for use in the event of any one motor being shut down, the others being left running. Provided the individual motors are fairly small, this starting device may well take the form of the double-throw switch dealt with under (1), as this may then also be used to isolate the motor for inspection and repair.

The notes above merely deal with standard three-phase squirrel-cage motors, although they apply almost equally to two-phase, three- or four-wire machines.

The star-delta starter method has its counterpart in the series-parallel scheme of connection for two-phase machines, the stator windings being divided into two parts connected in series for starting and in parallel for running.

In conclusion, it is important to see that all current-carrying and circuit-breaking surfaces are of ample area, because of the fact that the currents dealt with are usually much in excess of those required for D.C. or even slip-ring machines.

At the same time, as is well-known, the interrupting of the A.C. circuit, particularly under oil, can be more easily and satisfactorily accomplished than that of a corresponding D.C. circuit.

## ON CATALOGUES.

By H. R. TAUNTON.

Catalogues are issued by manufacturers and middlemen with two objects. The first, and most obvious one, is to induce you to place orders with them. The second is only to be guessed at after long and bitter experience: it is to wreak a subtle vengeance on you if perchance you withhold your orders.

As thus. Six mornings in the week you find a score of catalogues in the post. The majority are emaciated, flabby-backed things; others display the mis-shapen eccentricities of a Cubist enthusiast. One perhaps is normal in size and shape, and can stand on its own; none probably is of the least potential value to you. But weakly, as is your custom, you slam the lot with the others on the office mantelpiece, and there they lie, forgotten and useless; until in the fulness of time (and the mantelpiece) they slide off at the ends, and are borne away by the charlady.

No single order has resulted from their fleeting existence in your office. And yet they have not lived in vain! Every time you have had occasion to look up an item in some oft-used price list, these others, intent on vengeance, have clogged your search; hung limply round your fingers, or banged heavily upon them; disguised themselves as your objective, and being taken out, jibbed at being put back again; tumbled over each other, slid under each other, crushed and crumpled each other in their malicious eagerness to get in your way. When at length you find the list you are in quest of—either swallowed, like Joseph's kine, by some bulkier catalogue, or itself engulfing half-a-dozen smaller invertebrates—the whole mass leans ponderously upon your hands. You attempt, impatiently, to push them into unstable equilibrium for the moment necessary to enable you to withdraw the one precious volume you covet—and they incontinently topple over in the opposite direction, led by one bulky brute in the middle. "When father says turn, we all turn." Your ewe lamb is lost in the general débâcle; and you start all over again.

Two years of catalogue hoarding will reduce the strongest man to a nervous wreck; three years at the utmost, and he vanishes from friendly ken, and his relatives get touchy at the mention of his name. The various "systems" of keeping catalogues do but add fuel to the fire of madness. There are some who seek to classify their catalogues, dividing them into compartments in which they obstinately refuse to stay. Little wonder: the discomfort of a slim, paper-backed quarto, sandwiched between a podgy, "vest-pocket" list and a bulky octavo, bound at the short edge, is surely sufficient excuse for restlessness.

Others get over this difficulty by arranging their catalogues according to size, like a regiment of Boy Scouts. This is pretty, but unscientific. Others, again, would have their lists arranged alphabetically, or geographically, or ethnologically; or according to a colour scheme. On Monday they are all on parade, each in its place, standing at attention. On Tuesday they are scattered in skirmishing order, the weaker units crippled by the casualties of the preceding day. For the rest of the week they are all *hors-de-combat*.

Then there is the "Modern Methods" man. He puts quaint tags and labels on his library, and keeps a junior clerk and a typist constantly employed on an elaborate card index, guaranteed to mask the identity of a "general" catalogue in four volumes. Such a super-system was the rock on which one catalogue-haunted contractor of my acquaintance was catastrophically wrecked. Three policemen and a taxicab with difficulty prevented him proclaiming to Piccadilly at tea-time his sudden conversion to the Simple Life. This was immediately after discovering, on a pale blue card written by his favourite and most-trusted typist, a list of "Current-saving Devices" indexed under "Cooking Apparatus."

It is with some diffidence, therefore, that I put forward yet another system of keeping catalogues. It is not, perhaps, novel in all its details, but it has the merit of being as simple as it is effective. The idea is, briefly, to fix three shelves in any convenient recess, the space between the two bottom shelves being sufficient to accommodate quarto volumes, and that between the two top shelves to accommodate octavo volumes. On the inner sides of the top and bottom shelves, and both sides of the middle shelf, are a number of broad, shallow saw-cuts, at regular intervals of, say, an inch. These saw-cuts take pieces of painted sheet-iron, fitting between each pair of shelves. These pieces should be stout enough to be rigid, but an easy fit, and need not extend back for more than half the depth of the shelf. By their means the shelves can be divided up into any convenient number of compartments of any convenient size, readily altered when necessary.

The catalogues are then sorted according to subject. The electrical contractor, for instance, will have a compartment for "fittings" catalogues, one for "cables," another for "switchgear," and so on. A minute sub-division is unnecessary: a dozen different classes will probably be quite sufficient. It is easy to pick out any desired catalogue when it is one among not more than, say, thirty. It will be seen that there will be two compartments for each class, one for octavo, and the other for quarto. This is unavoidable; there are so many octavo catalogues issued that provision must be made for them, and it is hopeless to attempt to keep them with the quarto volumes.

Having sorted the catalogues into their several compartments, the next point is to ensure that they shall not stray from the fold, as is their wont, but shall retain their original classification, which is the point where all the usual systems break down. Each compartment, of course, is labelled. Take all the catalogues in compartment number one and stack them so that their backs lie flush, and then paint a band of white across the lot, half an inch wide, along the bottom edge. Treat the catalogues in compartment number two in the same way, except that the band of white paint is half-an-inch from the bottom. For the third compartment it is an inch from the bottom, and so on for each successive compartment. This half-inch band of paint is the key to the whole system. Its position on the back of the volume is a rough visual guide to the person replacing it as to the particular compartment it belongs to, without his having to reclassify it mentally; so that he will, without conscious effort, replace it correctly. If, by any chance, he does not, the mistake is seen at a glance: any volume with its distinguishing band at a different level to all the others in the same compartment is an obvious intruder.

I suggest white as it is practically the only colour not used for the binding of catalogues, and will therefore show up best. If there are a large number of different classes the bands may have to be made narrower, especially for the octavos; or they may be kept the same width—half-inch—and have their relative positions varied by shorter intervals.

We are still left with the problem of the leaflets, and pamphlets, and anæmic catalogues that cannot stand up by themselves. The best place for the majority of these is the waste-paper basket; but some of them must be kept. As most of the firms who issue them have not the common decency to supply a binder for them, the only thing to be done is to provide binders oneself. It is these wretched weaklings that are the cause of all the untidy confusion characteristic of the average collection of catalogues, and it is absolutely essential to the

success of any system that they be segregated. An octavo and a quarto binder, large size, will be required for each class, and in these the leaflets must be bound as they come in. If they are numbered, and an alphabetical index is provided in each folder, any required price-list can be readily found.

And what of the lanky folios, and podgy duodecimos, and the other crank-sided, double-jointed abominations beloved of printers? The upper side of the top shelf may afford a resting place for a favoured few, but the best rule to adopt is to destroy incontinently every catalogue that will not comfortably fit either the quarto or the octavo shelf. Most people save far too many catalogues; the whole problem would be immensely simplified if only those catalogues were kept that were in the least likely to be referred to within their currency. And the first ones to be weeded out should be those of abnormal size and shape; losing no opportunity of acquainting the senders with the fact, and the reason. If such a plan were consistently followed by all users of catalogues, the natural law of evolution would reduce all catalogues to the one size and type—a stiff-backed quarto—by the gradual conversion or ultimate elimination of all those short-sighted firms who seek to call attention to their wares by catalogues so very different to other people's as to require a special bookcase to themselves. What a waste of money, for instance, is the issuing of "vest-pocket" catalogues. Has anybody ever seen a sane business man carrying one about with him? Do the firms that issue them really think that a healthy-minded civilised being is going to leave his watch and chain, his fountain pen, his card-case and his cigar-holder, all at home in order to have four vest pockets free for the accommodation of catalogues? And if he has *one* pocket to spare, are there firms so blinded in their egotism as to think theirs is the one catalogue out of a hundred others he will select to serve him for mental pabulum? And if not, what is the good of issuing them? A "vest-pocket" catalogue is futility outside a vest pocket.

There is only one way of dealing with these and similar freaks, and that is the way of a certain Dublin contractor with catalogues in general. "The best way to keep catalogues, me bhoy, is not to keep them at all!"

## ANTENNÆ FOR COASTAL STATIONS.

The calculation of the inductance and capacity of an aerial from its dimensions is comparatively easily carried out, but the relative practical merits of various arrangements can be determined by practical experience alone. Formerly the chief concern of designers was to increase the effective radius of transmission of very heavily damped oscillations. This was accomplished by the use of narrow vertical "harp" or "screen" aerials, the capacity of which was very high. Such aerials proved satisfactory, and are still used in coastal stations working with low spark frequency and tight coupling. It does not follow, however, that this form of aerial is the best when higher frequencies, looser coupling and lower instantaneous pressures are employed.

Whereas new coastal stations have a sending equipment rated at over 5 K.W., the receiving requirements are becoming more and more stringent in all cases, and increasing attention must be paid to the characteristics of the aerial as a receiver. The vertical trellis aerial is a good sender, but reception is often as powerful and less distorted when a single aerial wire of the length of the main wave is employed. A horizontal aerial is very suitable for receiving purposes, hence, suggests a writer in "T.S.F.," the best form of aerial for coast stations consists of a vertical grid of wires connected to horizontal wires stretched between two masts—in other words, the bridge and tee-shaped aerials as used on board ship. The tee-formed aerial is specially suitable for wave lengths of about 300 metres and the bridge-form for wave lengths of 600 metres or so. These wave lengths are at present prescribed for public service stations. The possibility of changing from one to the other improves reception, assuming the antenna energy is not reduced by the use of supplementary self-induction and capacity. Bearing these facts in mind, provision is made for two independent aerials (one for 300 M. and one for 600 M. wave length) in each station. The London Convention made provision for yet another wave length (1,800 metres), but this is seldom employed in practice. The connection of additional self-induction in the 600-metre aerial adapts the latter for use with any longer wave length likely to be required.

The aerial equipment for a long-range station (using 10 K.W. primary power) would comprise masts 250 ft. in height, carrying:—(1) For 600-metre waves a network of five horizontal wires (190 to 200 ft. in length and 2½ ft. apart) at a height of 250 ft., connected at each end to five vertical downgoing wires. (2) For 300-metre waves a tee-shaped aerial having three 100-ft. horizontal wires (2½ ft. apart and suspended at a height of 160 ft.), connected centrally to three vertical wires forming the second downtake to the station.

A 5-K.W. station, having masts 45 ft. in height, might well have, side by side or one under the other, a four-wire aerial for 600-metre waves and a two-wire tee-aerial for 300-metre waves. These arrangements are said to have proved satisfactory in actual working, in materially increasing the loudness of reception over given distances, and thus in lightening the duty of operators while increasing the public value of the stations concerned.

## THE ALL-ELECTRICAL OPERATION OF THE PANAMA CANAL.

By JOHN GEO. LEIGH.

(*Continued from page* 290.)

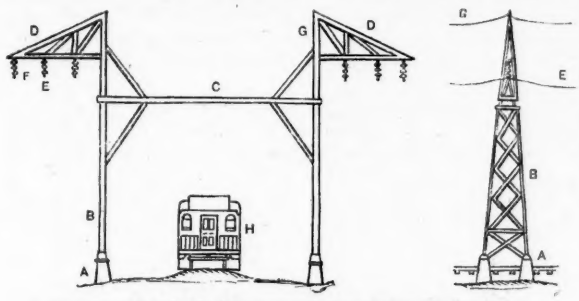
From the generating station the energy will be carried along the east wing of Gatun Dam by heavy cables in duplicate underground duct-lines, and through tunnels under the locks, into a transformer station, situated on the east side of the locks. The duct-lines are duplicated, so as to ensure against damage in the event of a burn-out of a cable in one or other of them, and are laid approximately 600 ft. apart. At the Gatun sub-station the energy will be transformed from 2,200 volts to 44,000 volts by means of three 2,000-KW. step-up transformers, other equipment being the necessary lightning arresters, oil switches, bus-bars, control board and auxiliary apparatus. From the sub-station will emerge two high-tension lines, running into duplicate transmission lines.

The transmission line crosses the isthmus from Cristobal to Balboa, permitting distribution of energy both ways from Gatun. Its erection has been not a little facilitated by the fact that the line parallels the Panama Railroad, by means of which material has been brought within a few yards of the point of its erection. At Cristobal and Balboa terminal sub-stations will receive the energy at 44,000 volts, less the voltage drop in the line, and convert the pressure, by step-down transformers, to 2,200 volts, which will be the distributing voltage for all circuits. At Miraflores there will be a sub-station for supplying energy for the motors and lamps of Pedro Miguel and Miraflores locks. If electricity is required along the line, the transmission lines will be tapped by an outdoor type of transformer sub-station. For example, at Caimito energy will be supplied to the

high-power radio station, and at Monte Lirio to the bascule bridge.

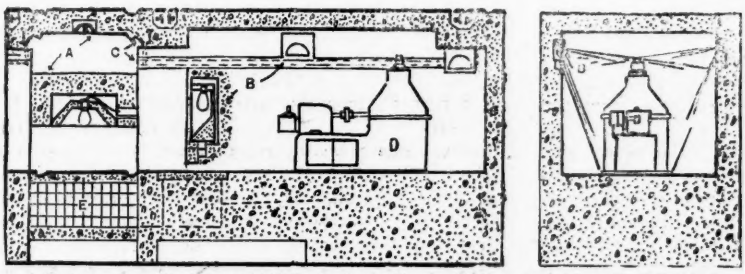
The present generating station at Gatun, which has been in operation during the construction period, may be abandoned in a year or so if conditions warrant complete reliance upon the water power. Temporarily, however, it will be included in the system, and until the transmission system is fully installed will be used to supply energy to Gatun locks.

In the following sketch, fig. 5, is illustrated the type of transmission line. Each of the three-phase conductor lines is




A, Concrete pedestals; B, Side frame; C, Cross bridge; D, Brackets; E, Three-phase transmission line; F, Suspension insulators; G, Ground wire; H, Panama Railroad car.

Fig. 5.—Rail-span Bridge, Cristobal-Balboa Transmission Line; Front and Side Elevations.




A, Reflector for ceiling lamps; B, Reflector for wall lamps; C, Chase for wiring; D, Cylindrical valve machine; E, Ducts for power and lighting cables.

Fig. 6.—Interior Lighting at the Locks.
(1) Operating tunnel in lock walls; (2) Detail of tunnel reflectors.

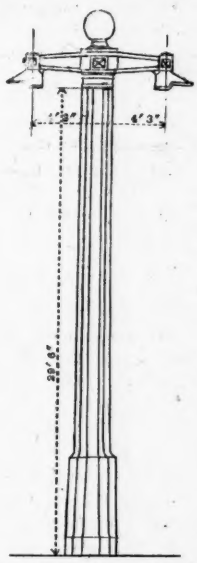


Fig. 7.—Lamp Standard for Exterior Lighting.

carried from suspension insulators attached to a side bracket. The conductors, No. 00 in size, are 5 ft. apart. The insulators are made of vitreous porcelain, in three units, and ample to sustain the impressed potential of 44,000 volts, while the fittings are of monel metal to resist climatic corrosion. A copper-clad $\frac{6}{16}$-in. ground wire is carried at the top of each side frame for protection against lightning. The steel bridges, of which 917 will be required, are spaced on 300-ft. centres. The span between side frames is 36 ft., and the bridges, in addition to supporting the duplicate transmission lines, admit of the suspension of a catenary trolley construction, for use in the event of the electrification of the railway.

Some features of the construction appear worthy of note. The side-bracket suspension of the conductors separates the duplicate lines so that a burn-out in one will in no measure affect the other, while the conductors, being outside the rails, will be comparatively free from deterioration caused by smoke from the locomotives. The conductors are seven-strand pure copper cables, the individual strands being manufactured without either a soldered or welded joint; splices are made with soft copper sleeves. As the conductors are suspended at the insulators from monel metal fittings, which are bushed with copper sleeves, there will be no point in the entire length of line where the copper strands are in intimate contact with a second metal. Thus there will be prevented the introduction of an electric couple and consequent electrolytic deterioration. At each span bridge the ground wire is clamped to the tower, and a positive T-connection is made to ground plates buried in the earth, the idea being thereby to reduce to a minimum line trouble and sub-station burn-outs caused by lightning. The insulators supporting the conductors are of two types, suspension and strain, each assembled of three porcelain disks, 10 in. in diameter, joined by monel metal fittings. This metal has been used on account of its unusual strength and ability to resist corrosion, the galvanised fittings customarily employed being practically worthless in the Isthmian humidity. The strain insulators, which hold the conductors more rigidly to a line, are used on sharp curves, two being required per bridge, and also for anchoring at intervals, the other type being reserved for use on tangents and light curves. The copper conductors along the line will aggregate in length about 2,000,000 ft.—1,500,000 ft. of No. 00 and 500,000 ft. of $\frac{5}{16}$ in.—and weigh approximately 530 tons; of strain insulators there will be 2,500 and of suspension insulators 4,000.

Among the permanent loads to be placed on the transmission system may be mentioned the following:—

Cristobal.—Docks, lighting and power, bakery, laundry, cold storage, ice plant, &c.

Mount Hope.—Coal-handling plant, Colon waterworks.

Gatun.—Lock machinery and lighting, Agua Clara pumping plant.

Monte Lirio.—Bascule bridge.

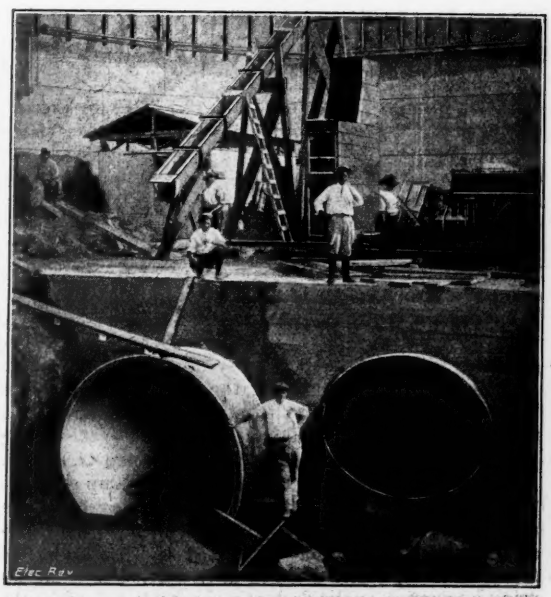



Fig. 8.—Electrical Conduit and Floor Culvert, Miraflores Lower Locks.

Caimito.—Wireless station.

Pedro Miguel.—Lock machinery and lighting.

Miraflores.—Lock machinery and lighting, water pumping plant.

Balboa.—Dry docks, permanent shops.

The lighting of all towns in the Canal Zone and of various aids to Canal navigation.

Also following the route of the Panama Railroad, there is being laid a four-way vitrified clay duct-line from Colon to Balboa, to contain the signal and telephone-telegraph cables. One duct is to be available for lease or rental, and the fourth will be left for future requirements. The ducts are laid on a base of concrete, 5 in. thick, and encased with 3 in. of the same material on the top and sides. There will be about 265,000 ft. of signal cable and 257,730 ft. of telephone-telegraph line. The duct-line is being laid at the rate of 1,500 ft. per day.

For the illumination of the locks there have been exhaustive studies, with a view to securing a distribution of light best suited to the varying conditions. In the end, there has been designed a distribution which, it is believed, will produce a correct and pleasing illumination, and an intrinsic brilliancy, causing the least possible inconvenience to the eye. The lighting required has been divided into three distinct classes—exterior, interior and machinery room—and for each of these a different system and different lamp unit are used.

The exterior lamp installation has called for particular attention. As ships will traverse the Canal at night, it is necessary, first, that a high intensity should be maintained on the coping and in the water chamber; and, secondly, that brilliant sources of illumination should be shaded from the eyes of an approaching pilot, thereby permitting an unrestricted vision of range and signal lights. The type of lamp finally selected is a large-power tungsten bulb (400-watt) set in a concrete hood (fig. 7). The area to be illuminated extends 300 ft. back from the lock chamber, Single-bracket standards will be used on the centre wall, where the lamps are staggered so as to illuminate both lock chambers; but on the side walls, for the purpose of throwing the light for a considerable distance at the back of the lock chamber, standards with double brackets are being placed. The reflector is of cast concrete, provided with shading skirts which prevent the glare of the lamp filaments from penetrating into distance along the axis of the Canal. The illumination on the lock coping will vary from 0·7 to 0·1 ft.-candle, and on the open water surface of the chamber from 0·25 to 0·1 ft.-candle. The entire reflector, with lamp and socket, is, of course, waterproof and designed to resist the effects of tropical deterioration.

All exterior lamp units are set 30 ft. above the coping, bracketed from an ornamental concrete standard of massive proportions conforming to the heavy masonry construction. These standards, of which there will be 511—211 at Gatun, 131 at Pedro Miguel and 169 at Miraflores—are being spaced on centres from 50 to 60 ft. Each double-arm bracket weighs, with reflectors, approximately 1,610 lb., and the solid ball finial, weighing 730 lb., will be employed to counterbalance the weight of the single-arm brackets used on the centre wall. Electrically, the lamps are connected alternately upon separate circuits, there being thus a duplication of wiring, as well as a means of economical operation whenever only half illumination may be required. Arrangement is made in the wiring so that all the circuits are controlled from the watch-tower centre from which all lock machinery and indicating apparatus are operated. This remote control is accomplished through solenoid-operated circuit-breakers, the main contacts of which connect the lamp circuit to the lighting bus-bar of each transformer room, the solenoid being connected to the control wires running from the transformer rooms to the control house.

Provision is made in the pedestal of each lamp standard for a special outlet box made of bronze, which permits the insertion of plugs to connect up portable lamp and telephone circuits. A portable lamp may be required at any moment in the operation of the locks to provide light upon a towing locomotive or the deck of a passing vessel, while the portable telephone is intended to enable a supervisor of lockages to communicate with the central control house from any position on the lock walls.

The tunnel which connects the various machine rooms and operating centres is 7 ft. in height, its floor being 8 ft. below the lock-wall coping (fig. 6). This will be lighted normally during daylight hours through deck-lights spaced longitudinally on 15-ft. centres, but for use at night or on dark days the illumination will be by 16-c.p. carbon-filament lamps, or 25-watt tungstens, set in recesses in the ceiling alternately with the deck-lights. For these lamps there has been cast a special concrete reflector (fig. 6). Of these reflectors there will be required at Gatun Locks 952, at Pedro Miguel 412, and at Miraflores 677. The lamps and reflectors used in the machine rooms differ only in the shape of the reflectors and in their setting, which is in recesses in the side walls, 6 ft. above the floor. Provision has been made at Gatun for the installation of 4,751 machine-room reflectors, at Pedro Miguel for 1,126, and at Miraflores for 1,524.

Both the tunnel and machine-room lamps are fed from panel boards, 66 in number, distributed throughout the lock walls. They are of the fused, branch-circuit type, with both main switch and branch switches. Among the machine rooms are also distributed 800 additional circuit switches, breaking the circuits from the panel boards into smaller groups, and 700 receptacles for portable lamps.

All the lighting is upon a 110-220-volt, 25-cycle, alternating current, three-wire Edison system. The copper wires possess large cross-sectional area to produce a minimum drop and consequently excellent regulation. To secure unusually good insulation, joints are avoided, the wires being looped into the lamp and receptacle terminals wherever practicable. The wires for lighting circuits run in longitudinal T-shaped chases, which are cast into the upper corners of the operating tunnel, and were covered with concrete after the installation of the wires. Branch chases also connect to all recesses and machine-room lamps.

Recent experiments and trials have demonstrated the advantages of the interior lighting arrangements described above. The proposed use of concrete reflectors was due primarily to the consideration that metal corrodes rapidly in the tropical humidity. Later, however, it was suggested that steel fixtures specially enamelled should be manufactured in the United States, and tenders therefor were duly invited. These proving unsatisfactory, as regards both price and anticipated illumination, the Commission engineers were encouraged to work up new designs of concrete reflectors likely to be suited to local requirements. The reflector adopted for the tunnels is of comparatively simple design, consisting of inclined surfaces at the four sides to throw the light in proper directions. In the top of that used in the machine room is set a lamp socket, and in front of the lamp is placed a concrete shade with a semi-circular opening at the bottom, this shade being adjusted in a vertical plane so as to cut off from the eye the direct glare of the filament, and permit the light to penetrate through the opening and flood the machine.

The same experiments went far to demonstrate the superiority for the purposes required of the tungsten-filament lamp. Two adjacent rooms in the centre lock-wall were fitted up with four concrete reflectors; in one were used 16-c.p. carbon-filament lamps, and in the other 40-watt tungsten lamps. The illumination with the latter was pronounced greatly superior, the yellow light emitted by the carbon lamps being inferior to the white light produced by the tungstens. Forty-watt lamps were used because of temporary inability to procure sufficient 25-watt lamps. It was considered that the tungsten illumination, represented by 100 watts per room, was much superior to that of the carbon-filament lamps, represented by 220 watts.

In the past some fear had been entertained concerning the life of tungsten lamps when subjected to possible vibration caused by passing locomotives and the operation of machinery. It appears, however, to be now evident that the stability of the lock walls and decking will render this vibration of small moment.

*(To be continued.)*

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**Fire.**—By a fire at the Ballachulish State Quarries, the gas engines, electricity plant and engine house were completely destroyed.

## A PETROL-ELECTRIC ROAD TRAIN.

[BY OUR BERLIN CORRESPONDENT.]

A remarkable petrol-electric road train has recently been constructed by Messrs. W. A. Th. Müller, Ltd., of Berlin-Steglitz, consisting of a power car and ten trailers, each of 5 tons capacity.

The power car carries the generating set, viz., two Daimler motors, each of 125 H.P., driving a dynamo installed in the centre. The current is transmitted to electromotors driving each of the wheels of the power car and trailers. The armatures of these motors are arranged in parallel, and the fields in series; the former derive their current from the main dynamo, whereas the latter are fed from an exciter machine which, at the same time, serves to excite the main dynamo. The field regulator of the main dynamo controls the voltage of the armature and, accordingly, the speed of the train. A loop circuit allows a perfect uniformity of pressure to be ensured in all motor armatures. The motor fields are controlled by a special "traction regulator," inserted into the exciter circuit, and the direction of travelling is controlled by reversing the excitation of the motor fields. This arrangement presents the advantage of eliminating from the trailers all controlling apparatus necessitating any superintendence. The electric apparatus and instruments are arranged on the power car, above the dynamo, so as to be readily accessible.

Fig. 1.—View of Complete Power Car and Train.

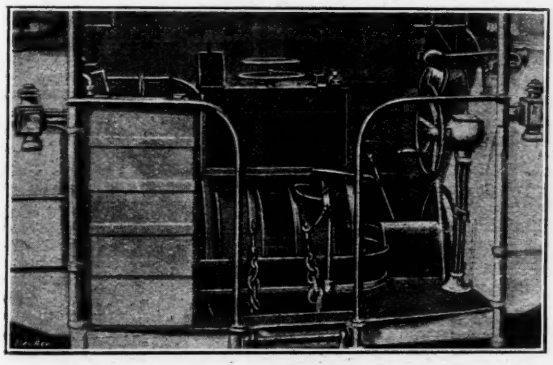

Fig. 2.—Interior of Power Car, showing Twin Dynamo.

The steel rims of the wheels are 1·2 m. in diameter and 250 mm. in width. Thanks to the identical construction of all the trucks, the number of spare parts is reduced to a minimum. Chain transmission has been used to connect the trucks with one another, and the inside brakes formerly used have been replaced by outside brake shoes acting directly on the circumference of the wheels, thus greatly facilitating the superintendence of the brakes.

The net weight of the power car in full working order is 9 tons, and that of the 10 trailers, 3 tons each. The ratio between the carrying capacity and the net weight thus works out at 50 : 39 = 1·3, which is 30 per cent. more favourable than in the case of heavy vans. The mean travelling speed is 12 km., and the maximum speed 16 km. per hour.

Since all the wheels of the train are driving wheels, its total weight is utilised for adhesion. The steel rims are cylindrical, slightly slanting towards the edges. The surface of the road is thus exposed only to a stress of 80 kg. per centimetre width of the wheels.

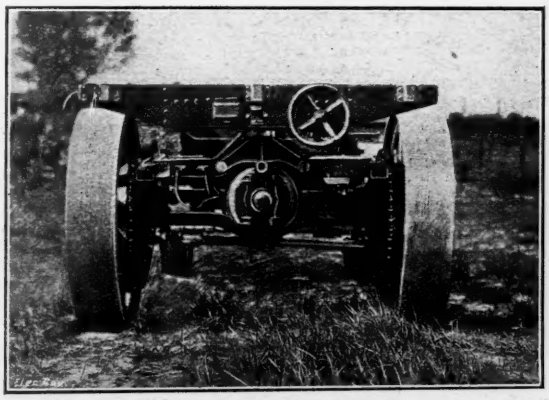

Fig. 3.—End View of Truck, showing Motor.

The train is controlled from the driver's cabin.

## SOME RAILWAY CONDITIONS GOVERNING ELECTRIFICATION.

By ROGER T. SMITH, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *February 12th*, 1914.)

It seems reasonable that if any change from steam to electricity is proposed by electrical engineers, they should first endeavour to provide something which will at least do what steam will do, next try to give electrically what steam cannot give, and, finally, do this in such a way as will result in improved financial prosperity to the railway. It is far easier to change things than to change the

habits and inherited instincts of large bodies of men. Any proposal, otherwise economically correct, that will suddenly alter the way in which large bodies of men have been used to handle traffic in the past is not sound engineering or sound business, unless the resulting gain is very considerable.

It is convenient to divide railway services into three groups, which correspond to entirely different conditions as far as traction is concerned:—

1. Urban and suburban passenger services.
2. Fast passenger services.
3. Fast or slow goods and mineral service.

### 1.—URBAN AND SUBURBAN PASSENGER SERVICE.

Urban electric service differs only in degree from suburban service. Steam traction for underground services is out of the question in the 20th century.

A suburban passenger service exists to enable a working and business population to live outside the town in which it works. In this country suburban transport has mostly grown haphazard with the population, and its extent is governed by the time which people consent to spend in the train between their homes and their business occupation. Excluding outer suburban service, the limit may be taken to be about 45 minutes each way. The greater the distance covered in that time, that is to say the higher the schedule speed (average speed including stops) of the train, the more chance has the railway of creating new traffic.

If a railway possessing a suburban system equipped with permanent way, platform accommodation, and locomotives designed for a certain time-table finds this equipment outgrown by the traffic, it is obvious that it must increase the number of coaches run in a given time. To do this several courses are open.

First, it may double or treble the number of tracks and increase both the number and length of its platforms, thus increasing the number of passengers carried without necessarily increasing the journey schedule time. This has been done on several of the London railways with suburban services, the cost of widening the line and rebuilding the stations having been enormous.

Secondly, the railway may retain its permanent way and stations and with them the maximum length of its trains, but increase their schedule speed by using the biggest type of steam locomotive permitted by the load gauge for running comparatively light suburban trains.

Thirdly, the railway may electrify, which solution is commending itself to many of the railways in this country with congested suburban services. With electrification a maximum of 48 trains an hour can, if required, be run each way during the rush hours while employing existing stations and tracks. That it is possible to run trains so close to each other is chiefly due to signalling by track circuits, but full advantage of the possibilities of running up to 40 or more trains per hour by the use of track-circuit signalling can only be taken by trains having rapid acceleration and very rapid deceleration. With tracks and stations (and hence also the train length) remaining as before, the number of passengers carried per hour has in many cases been doubled by increasing the scheduled speed 50 per cent., while improved signalling has at the same time made it possible to increase by 50 per cent. the maximum number of trains per hour.

The characteristics of urban and suburban services for which electric traction is suitable are a dense or fairly dense service of not less than, say, 5 trains per hour each way, up to 40 and more per hour each way, with station stops varying from less than half a mile apart up to 1½ miles apart. With services less dense than the minimum, and with stops further apart on the average than the maximum here given, the advantages of electric traction, if they exist, are special and not characteristic.

The essential element which gives to electric traction its advantage over steam under these conditions is the motor-coach train. The train is made up either entirely of motor coaches (as in the western suburban system of the French State Railways), or of motor coaches and trailers. The number of motor coaches must be such that the weight on the driving wheels available for adhesion is not less than 25 per cent. of the total train weight. It is more often 33 per cent., and may be 100 per cent. The making up and driving of such trains has been rendered possible by multiple-unit control.

With the motor-coach train it is quite easy to have such an adhesive weight as will permit of a tractive effort, over and above that required to haul the train against resistances, sufficient to accelerate it during the notching period at rates up to 1½ miles per hour per second (2·2 ft. per second per second), while the rate of deceleration is usually increased up to 2 miles per hour per second. Such a rate of acceleration is not often justified, and a more characteristic example may be taken from one of the London suburban services where trains weighing 175 tons are accelerated during the notching period at 1·7 ft. per second per second to give with 20-second stops a schedule speed of 17 miles per hour, the station stops averaging half a mile apart. The adhesive weight is 46 per cent. of the train weight, and the energy input while accelerating is 1,300 H.P. Within the load gauge of this railway no steam locomotive could be built of such a power. The cost in energy is shown by fig. 1, representing actual tests of 20 such trains, including the moving and controlling of the train only.

Other advantages of the multiple-unit-controlled motor-coach train are, first, the doubling of terminal accommodation by halving the number of signal and locomotive movements; and, secondly, the ability to make and break up the motor-car and trailer units of which the maximum train is composed to suit the traffic.

No piece of apparatus is more fitted to accelerate a train rapidly than an electric motor with a series characteristic. The series-parallel-connection of the continuous-current motor can give without opening the circuit two running speeds for each definite load after acceleration is complete, while in the single-phase motor, voltage regulation can give as many running speeds as are desired.

For any suburban service requiring 20 trains per hour to bring morning passengers in and take evening passengers out of a city,

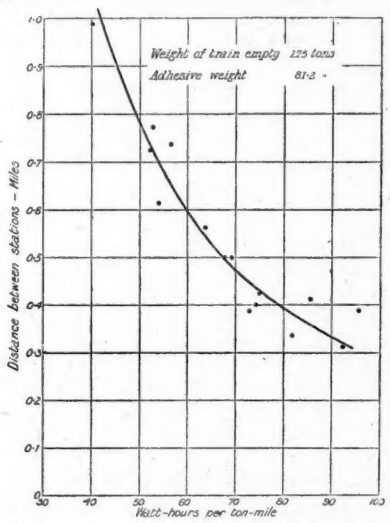


FIG. 1.—CURVE OF ENERGY CONSUMPTION FOR LONDON SUBURBAN MOTOR-COACH TRAIN.

tracks and terminal accommodation must be set apart exclusively for the purpose.

In general it is safe to say that until it is necessary to devote terminal facilities, station accommodation, and at least two tracks entirely to a suburban service, it is very doubtful if electrification is the only solution of the congested traffic problem, although it may prove to be the best solution. Such a service can be electrified on any system which best suits its conditions, and the method may be quite different from any other method which may subsequently be desired for main-line electrification.

The results of suburban electrification all the world over show that there are really no fresh engineering problems to be solved. When the traffic department asks for any reasonable schedule, the engineer is not only able to design his equipment to work to it, but can say within very close limits what it will cost in power and maintenance.

The question of the electrification of a suburban system has become for a railway company purely one of finance. Essentially it resolves itself into a question as to whether the fares charged for the service, even with the additional traffic obtained, can give a reasonable return, or any return at all, upon the new and old capital, after the cost of working has been provided for.

Even when the management cannot make the development of its suburban traffic pay directly, it may still pay the railway as a whole considered only as a feeder to the main line, or urban and suburban traffic as a whole may pay if the latter goes far enough out into the country. The latter type of suburban service is best illustrated by the Liverpool-Southport electrified system on the Lancashire and Yorkshire Railway.

From Liverpool to Hall Road, 7½ miles away, the average distance between stops is ¾ mile and the schedule speed is about 25 miles per hour. This is probably the most rapid suburban service in existence. From Liverpool to Southport is 18½ miles, with an average distance between stops of 1½ miles, but beyond Hall Road this average is only a little under 2 miles. The schedule speed of stopping trains is 30 miles per hour. The maximum instantaneous input to the train is nearly 2,000 H.P., and the power consumption for the stopping trains to Hall Road is about three times the power averaged over the whole service of stopping and express trains and idle mileage. This is an excellent example of how a service if extended far enough out and combining express with stopping trains reduces the energy used over the whole system to a reasonable figure. The long-distance fares have to make up for the far greater cost of the short-distance stopping service.

Not only have electrical engineers completely solved the engineering problem of frequent service with short distances between stops, but the cheap and simple measurements of electrical quantities have taught railway companies for the first time how costly the constant stopping and starting of a train must be as compared with running at high speeds with infrequent stops, whatever form of power is used for traction.

At the present moment it is safe to say that everybody in London and its suburbs is being carried at too low a fare to give proper remuneration to any form of traction which, in addition to rates and taxes and Government duty on some fares, pays for its road and the right to use it.

If the suburban systems of the main-line railways running into London are left out of account there has on the whole been no increase during the last three years in the number of passengers carried by the underground railways of London, all of which are electric.

The total number remains stationary at about 436,000,000 passengers per annum. The purely London traffic of the main-line railways—inclusive of their suburban traffic—is estimated for 1912 as 250,000,000, which is a decrease of 1¾ per cent. on the traffic of the previous year.

Greater London traffic as a whole increased by 125,000,000 passengers in 1912, which is 20 per cent. less than the omnibus increase, every other form of traffic having declined except that on the underground railways, which remained stationary.

Like most other industrial working costs, that of running a suburban service depends on certain standing charges which, taken as a whole, do not vary, or hardly vary, with the service given (upkeep of permanent-way equipment, management, rent, rates and taxes, and station traffic expenses), and a charge varying with the service catered for (rolling stock, repairs and wages, running wages and electricity). In a particular case the ratio of standing to variable charges for running a small suburban service for a year was as follows:—Standing charges unaffected by the number of trains, 60 per cent.; variable charges, 40 per cent.; and of this 40 per cent. electricity formed three-fourths.

If the cost of electricity can be reduced by 50 per cent., the total working costs may be reduced by one-quarter, which shows the importance of cheap electricity. This is a particular case where the cost of electricity was high, and as a rule its percentage effect is not so great.

Fig. 1 shows how, for a given average schedule speed, the distance between stops affects the amount of electricity used, and supposing it were possible to have a differential tariff for railway passengers based on the actual cost of the service, the short-distance passenger ought to pay much more per mile than the long-distance passenger, since he costs more to carry; but on nearly all suburban services competition has cut down the fares of the short-distance passenger to a non-profitable point.

What is wanted to make urban traffic on electrical lines pay is either an increase in the fares, which is achieved abroad by zone fares, or the ability to purchase electrical energy delivered to the conductors at, say, ¼d. per KW.-hour. Competition may prevent the former. Is there any chance of obtaining cheaper electricity?

The generation of electrical energy and its supply is a business in itself. In general, the addition of a load which, in the case of a heavy suburban service, may continue during 18 or 20 hours out of the 24, with an annual maximum demand load factor of from 45 to 55 per cent., should enable a supply authority with a light and power load to offer a railway company such a price as would leave no question as to its acceptance. However, the purchase of electrical energy has not been the policy of the majority of the railway companies. Some of them have had no chance of buying, but those like the North-Eastern and London, Brighton and South Coast Railways, who have purchased electrical energy, have no reason to regret it.

The cost of electric working is important, but the cost of money may be still more important, and the raising of fresh capital for anything that is not certain to swell the dividend is a very serious matter indeed at the present time when the credit of British railways stands so low.

## 2.—FAST PASSENGER SERVICE.

When the condition of frequent stops and short distances between them is left, and the question of main-line passenger services as run by steam locomotives is considered from the point of view of electric traction, the problem alters completely.

A seven-coach train hauled by a steam locomotive at an average schedule speed, including stops, of 40 miles per hour, the stops being 23½ miles apart, and the same train, run at an average schedule speed of 27 miles per hour, and stopping on the average every 5½ miles, required practically the same average draw-bar horse-power. The time taken to do the same distance is in the ratio of 1 to 1½, so that the energy used for the stopping service for the same distance is 50 per cent. greater than for the fast service.

A good deal of experimental and pioneer work has been done on the Continent and in the United States in electric locomotive design, but the engineering problems which have to be solved in this country before fast passenger electric services can compete with existing services have hardly been considered.

The chief difficulty in the way of electrification for fast passenger services is the existence of the steam locomotive. Fig. 2 gives curves kindly supplied to me by Mr. G. J. Churchward, of draw-bar pull plotted against the speed for two types of steam locomotives, one for passenger service (the 4-6-0 type*) and one for goods service (the 2-8-0 type). The curves represent the average results for saturated steam of many experiments with each type of locomotive hauling actual trains, the draw-bar pull being measured by the dynamometer car. The two types of locomotives may be taken as representative, one for hauling fast passenger trains and the other for hauling fast goods trains with nearly the maximum loading on the coupled axles permissible for British permanent way and structures. They also represent approximately the maximum powers which can be developed by steam locomotives built within British load gauges, which are not the same for all our railways. Constant-output draw-bar horse-power curves are added for guidance. Curves of an American and of a French steam locomotive of the 4-6-2 or Pacific type are added for comparison.

The steam locomotive is so designed that with earlier and earlier cut-off as the speed increases, practically constant outputs are obtained for the same load. The timetables of British railways imply maximum speeds of between 70 and 80 miles per hour. The resistances to train movement increase in proportion to the speed raised to the $\frac{5}{3}$ power, so that for trains running with infrequent stops a locomotive with constant output has sufficient reserve of power at low speeds, over and above that required to overcome resistances, to give a moderate acceleration (up to the limit

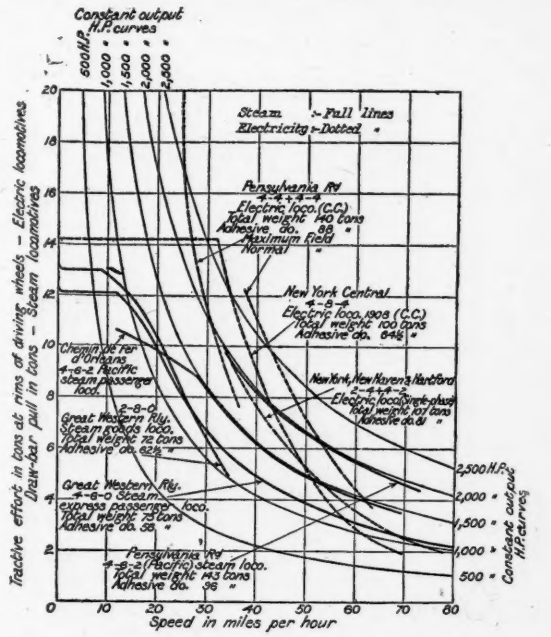
Constant output H.P. curves
500 H.P.
1,000 "
1,500 "
2,000 "
2,500 "
Steam - Full lines
Electricity - Dotted "
Pennsylvania Rd 4-4+4-4 Electric loco. (C.C.) Total weight 140 tons Adhesive do. 88 " Maximum Yield Normal "
New York Central 4-6-4 Electric loco. 1908 (C.C.) Total weight 100 tons Adhesive do. 64½ "
Chemin de fer d'Orleans 4-6-2 Pacific steam passenger loco.
New York, New Haven & Hartford 2-4-4-2 Electric locomotive Total weight 107 tons Adhesive do. do. "
2-8-0 Great Western Rly. Steam goods loco. Total weight 72 tons Adhesive do. 62½ "
Great Western Rly. 4-6-0 Steam express passenger loco. Total weight 72 tons Adhesive do. 36 "
Pennsylvania Rd 4-8-2 (Pacific) steam loco. Total weight 143 tons Adhesive do. 96 "
Tractive effort in tons at rims of driving wheels - Electric locomotives
Draw-bar pull in tons - Steam locomotives
Constant output H.P. curves
2,500 H.P.
2,000 "
1,500 "
1,000 "
500 "
Speed in miles per hour

FIG. 2.—CURVES OF MAXIMUM CONTINUOUS DRAW-BAR PULL (STEAM LOCOMOTIVE) AND MAXIMUM TRACTIVE EFFORT AT DRIVING-WHEEL RIMS (ELECTRIC LOCOMOTIVE) PLOTTED AGAINST SPEED.

imposed by the adhesion of the coupled wheels) and to maintain the train at any speed (determined by the regulator and the cut-off) up to the maximum speed with that load.

As compared with the electric locomotive the steam locomotive is handicapped by the distribution of weight due to the length of the boiler. In the former, from the shape and size of the motors it is possible to get a greater ratio of adhesive to total weight than in the latter, especially if every axle is driven. In general for fast passenger service the acceleration of the steam locomotive is limited not only by the boiler capacity but by the maximum adhesive weight on the coupled driving wheels.

For the 4-6-0 type locomotive, the adhesive weight being absolutely limited by structures to 60 tons, and by usual practice to 56 tons, the starting draw-bar effort is limited to about 16 tons. From the start until the driving wheels are moving at about 50 R.P.M.—say, about 12 miles per hour for the engine under discussion—the maximum draw-bar pull is 12 tons, determined by the adhesion.

Such a passenger engine can haul a train of 450 tons on the level at the highest speeds called for in this country and, unassisted, a train of 300 tons up a gradient of 1 in 50. To haul such a train, a constant-output locomotive is satisfactory, and the control of the output and speed by the regulator and cut-off is so complete that the steam locomotive can run at any speed below its upper limit for the load hauled.

With the exception of certain three-phase locomotives in Italy and America, all the electric locomotives built have been equipped with motors having series characteristics. At any given voltage the series motor has one speed for each definite load. Series-parallel control with continuous-current motors gives two speeds, and with certain numbers of motors three speeds for continuous working can be obtained.

Since the series motor can be overloaded momentarily 75 per cent above its hourly rated capacity, while for adhesion purposes if necessary every axle can be made a driving axle, even greater starting torques than those shown in fig. 2 are possible, but on British railways they would be not only useless but actually harmful, exceeding the draw-gear strength. Unlike the case of the multiple-unit train, the adhesive weight may be only 12 or 14 per cent. of the total train weight, and the strength of the draw-gear limits the draw-bar pull after starting to 12 tons. But with an increase in speed the torque of the series motor falls off so rapidly that above 60 miles per hour (where difficulties begin with steam locomotive design) no electric locomotive yet built for hauling only such maximum loads as obtain on our railways could give anything like 1,100 H.P. at 70 miles per hour, as given by the 4-6-0 steam locomotive shown in fig 2.

* There is no uniformity in different countries in the symbols used for types of locomotives. This paper follows American and British steam practice, thus 4-6-0 indicating a leading four-wheeled bogie, six coupled driving wheels and no trailing pony or bogie. 2-8-0 indicates a two-wheeled leading pony, eight coupled driving wheels and no trailing pony or bogie; 4 — 4 + 4 — 4 indicates an articulated locomotive with leading and trailing bogies and four driving wheels in each half

Fig. 2 shows tractive effort curves of a very fairly modern American electric locomotives, the loads representing not draw-bar pull but tractive effort at the rims of the driving wheels, so that the hauling of the locomotive itself is included. They are added to show how very quickly the tractive effort at the rims of the wheels falls off at high speeds. Such locomotives are only of academic interest to us, as their starting effort is quite beyond the strength of draw-gear on British railway passenger stock.

One object of the series winding is to saturate the field of the electric motor at starting, and provided the field is saturated, no extra current through the winding is of any use. The field can equally well be saturated by separate excitation, which opens the possibility of a shunt characteristic with variable speed for the continuous-current motor, voltage variation already providing several running speeds with the single-phase motor.

The very interesting experimental line equipped by the Lancashire and Yorkshire Railway for 3,500-volt continuous-current electrical working between Bury and Holcombe Brook has two motors on its motor coaches permanently in series and a motor-generator for providing current at 100 volts for the auxiliary service of control, brake pump, lighting and heating. The same principle could be used for exciting the field, and it is suggested that such a method of obtaining the series characteristic at starting and the shunt characteristic for higher speeds is worthy of consideration.

Up to the present time no electric locomotive has been made suited to our maximum loads which can replace the fast passenger steam locomotive in this country.

Turning from the engineering to the economic side, and assuming a suitable electric locomotive has been built, a very rough estimate may be made of the cost of working.

The annual cost of a steam passenger locomotive, averaged over all the different types in use on a railway carrying passengers, goods, and minerals over not less than 2,000 miles of route, and hauling its own locomotive coal, may be taken to be £825 for such items as do not vary with the mileage run or only vary to an extent which will not affect this first approximation. The annual cost of coal at about 9s. per ton per 10,000 B TH.U. averaged over the whole working together with the cost of water may be taken to be £350, giving a total for the year of £1,175, inclusive of capital charges. This is a mean for all locomotive types working an average passenger mileage of 10,000,000 train-miles per 1,000 miles of route. During the year a passenger engine may be expected to run between 25,000 and 30,000, or, say, 27,000 passenger train-miles, so that the mean cost for locomotive expenses (including locomotive capital charges) per train-mile will be 10½d.

Of the above sum of 10½d. per train-mile, 3d. per train-mile will represent the cost of coal and water. Cheap coal in this country is one of the factors making against railway electrification. The cost of coal burnt in a large modern generating station producing electricity for hauling trains by an electric locomotive is less than half the cost of coal for doing the same work in a steam locomotive. In America coal costs about the same as in England, but in France the 3d. per train-mile for coal and water would be at least 6d., and in Switzerland and Italy 9d. or more. The influence of the cost of steam locomotive coal in non-coal-producing countries, more especially where water power is available for generating electricity, becomes obvious.

Mr. Hobart works out the efficiency of a Pacific type 4-6-2 steam locomotive between the heat value in the coal in the tender and the work done at the draw-bar at 3¼ per cent. He also quotes the actual efficiencies obtained between the heat value in the coal in the bunkers of a large modern electric generating station using similar coal and the work done at the draw-bar of an electric locomotive for similar work, and finds it to be 6 per cent., after his constants have been altered to suit English conditions in both cases. Working from these efficiencies the result is obtained that the cost of electricity per passenger train-mile is about the same as the cost of coal and water per passenger train-mile hauled by the steam locomotive, provided that electricity can be bought at ½d. per KW.-hour.

Weight for weight the electric locomotive costs about twice as much as the steam locomotive, but for the same adhesive weight the electric locomotive weighs some 30 to 40 per cent. less than the steam locomotive. Electric repairs and renewals cost less, and the net result is that the annual cost of the electric locomotive will be in the neighbourhood of £1,250 per annum, assuming the same rate for capital charges.

But while the passenger steam locomotive only runs on the average 27,000 train-miles in the year, spending 75 per cent. of the time out of active service, the electric locomotive, which need only be in the shops for one month out of the 12, will not spend more than 50 per cent. of its time out of active service. The electric locomotive can run at least 40,000 passenger train-miles per annum. Multiple-unit motor-cars runs 45,000 to 50,000 miles per annum.

If these figures are accepted, the cost per train-mile with the electric locomotive (including locomotive capital charges) will be 7½d., always assuming that electrical energy can be bought at ½d. per KW.-hour.

If a saving of 3d. per train-mile was secured by electrification, representing the charges on a capital of £2,100 per mile of route, this sum would certainly not cover the corresponding electrical equipment of the line on an overhead system, inclusive of contact wire and structures, distributing cables, bonding, and sub-stations.

The only items for which a reduction in costs may be expected are the cost of electricity and the capital cost of electric locomotives. No great reduction in the cost of the former can be expected so long as railways generate their own electrical energy, as there must be a diversity of load and generation on a scale far beyond railway requirements to secure an appreciable reduction in price. If electrical energy could be bought at ¼d. per KW.-hour, and the electric locomotive could be made for £50 per ton, the cost per train-mile in the above estimate would be reduced to about 6d.

The problems in front of the electrical engineer who would compete with the passenger steam locomotive are therefore first to design an electric locomotive that will do what the steam locomotive does at high speeds; secondly, to reduce the cost of the electric locomotive (which will come about when there is sufficient demand for it); and thirdly, to be in a position to buy electrical energy at something approaching the ½d. per KW.-hour which forms Dr. Ferranti's ideal.

### 3.—Fast or Slow Goods and Mineral Service.

For goods and mineral service the outlook is different. The same comparative ratio of cost between coal and electricity per train-mile would hold with electricity at ¼d. per KW.-hour—the price at which it can in some cases be obtained to-day—in place of the ½d. per KW.-hour assumed for passenger service.

Considering English conditions, the chief difference between goods service and passenger service is the reduction in the annual train mileage run by the steam locomotive. Whereas for steam passenger service it was taken to average 27,000, for goods and mineral service it drops to 10,000 train-miles per locomotive. In addition to this, the coal per train-mile is nearly doubled. Each goods engine in steam may not work more than 40 to 50 train-miles per day averaged throughout the year, which gives some idea of the length of time the locomotive is standing in steam and using coal, but earning nothing, while nearly one-third of the engines are away under repairs.

It is in this direction that the electric locomotive appears to have its best chance. In America it has been found to be possible at least to double the daily mileage run by a steam locomotive, owing to the ability of the electric locomotive to haul heavy loads at an increased speed, while it wastes no energy while standing idle. Not more than 10 per cent. of the electric locomotive year need be spent in the repair shops.

In America the strength of the draw-gear is such that draw-bar pulls of more than 30 tons are permissible, and trains of 3,500 and 4,000 tons weight can be hauled if fitted with continuous brakes. In British goods and mineral service the limiting factor is the strength of the draw-gear, which is tested to 50 tons, and with a factor of safety of 4 is supposed to be worked at a maximum load of 12 tons. At the present time there are some 700,000 wagons owned by traders liable to be run on British railways.

On lines with no adverse gradients it is possible at times to haul trains of 100 wagons weighing 1,600 tons, but that is the exception in this country. Goods trains of 56 wagons weighing 900 tons can be taken by a 2—8—0 engine up gradients of 1 in 150, and of 24 wagons weighing 380 tons up gradients of 1 in 50, without endangering the draw-gear, and as a general rule longer trains than 60 wagons are not conveniently dealt with in the usual lay-by sidings, although trains of 100 wagons can be handled in suitable places. We are not, therefore, really limited in our train weights by the maximum size of steam locomotive which can be built within the restricted British load gauges, but by the strength of draw-gear and the lay-out of sidings. The draw-bar pulls of the American electric locomotive shown in fig. 2 if used on a British goods or mineral train would merely break the couplings.

One class of traffic in this country is happily free from this drawback, and that is the mineral traffic of the North-Eastern Railway on the north-east coast. The railway owns the coal and ore wagons, or the greater proportion of them, and not being handicapped by traders' wagons, can maintain the draw-gear at the required standard. They are fortunately situated for the bulk of their heavy mineral traffic in a district served by the North-East Coast Electric Power Companies, and can buy electricity cheaply.

The mineral line between Shildon and Newport (Middlesbrough), a distance of 18 miles, is now in process of being electrified, the length of single track and sidings amounting to 50 miles. Two sub-stations on the route will supply continuous current at 1,500 volts, for the most part through overhead conductors and through a protected conductor rail in places where an overhead conductor is inconvenient.

The locomotives will be able to start and haul mineral trains weighing 1,400 tons at a speed of 25 miles per hour on the level, and start an 800-ton train on a grade of 1 in 100.

Apart from suburban electrification this is the most interesting railway electrification which has been contemplated in this country, and if successful it will undoubtedly be the real beginning of goods electrification. Its working this year will be a matter of great interest to electrical and railway men.

While the cost of everything in the industrial world has been going up, increasing the expense of many things that a railway has to buy, including labour, the railways have not hitherto been able to increase the price at which they sell transport.

However much expenses may increase, practically no corresponding increase in the revenue from passengers can follow; and it is largely for this reason that the substitution of the electric locomotive for the steam locomotive can only be considered if the result is going to reduce the ratio of expenses to gross receipts by such an amount as will increase dividends.

The methods of electrification available for the consideration of the engineer are varied, but for goods working involving the equipment of sidings some form of overhead equipment seems imperative.

The electrification of goods and mineral lines is likely to begin only in favourable districts, especially with steep grades where the overload capacity of the electric motor and its accelerating ability

will enable traffic, which is now very slow, to be speeded up. This will increase the earning capacity of the existing permanent way without costly re-grading.

The electric shunting engine is a very good example of what has to be done in the matter of suitable design. A shunting engine may be called upon for hours to push heavy trains of wagons at 2 or 3 miles per hour and then to clear away a train of empties at 25 miles per hour. It is frequently called upon to push or pull a heavy loaded train over a weighbridge with a pause long enough for the weight to be recorded while each wagon is on the bridge. This the steam locomotive can do, but the continuous-current series-motor locomotive with continuously rated resistances seems hardly an engineering competitor of the steam locomotive for such work as this. There is far more hope for the single-phase locomotive.

To sum up the position as it appears to the author, the inherent advantages of the electric locomotive for goods and mineral haulage are, first, its ability to haul up to the maximum strength of the draw-gear at more than double the speed possible with the most powerful steam locomotive which can be built within British load gauges; secondly, the ability, if necessary, to have all axles driven, so that the whole weight of the locomotive is available for adhesion, while the weight per axle is sensibly reduced; thirdly, the advantage that any driver can work any locomotive, which is not the practice in this country with steam locomotives; fourthly, the ability to run annually at least twice as many train-miles as the steam locomotive, partly due to increased speed, and partly due to less time spent in the repair shops and for cleaning; fifthly, the saving of all coal wasted by the steam locomotive when getting up steam, standing in steam, and left in the firebox at the journey's end, with the result that with electrical energy at ½d. per KW.-hour the bill for current per mile is about the same as the bill for coal and water per mile; sixthly, the possibility, when the strength of the draw-gear permits, of loads being hauled quite beyond the capacity of any steam locomotive that can be built within our load gauges. The electric locomotive takes its power from a generating station, and not from a moving boiler; it can therefore be designed to give its maximum draw-bar pull at any desired speed. It is for the electrical engineer to make the most of such advantages.

### Discussion.

Mr. H. W. Firth, in opening the discussion, said the author emphasised the greatest drawback in connection with expenditure on electrification, *i.e.*, the small return from passenger traffic. The companies could not help themselves in this, although they were expected to give improved services. Electrification might pay if it were possible to secure 100 per cent. load factor, but rush hour or peak load traffic involved capital lying idle. Electric traction had shown its ability to increase passenger traffic, but the published figures must be taken with caution, as the character of the district and previous service had to be taken into account. The limiting factors were financial and traffic ones, and 48 trains an hour each way could not be accommodated on most lines, even with separate electrical tracks, as conflict with other services was bound to occur. It was not always possible to restrict certain rolling stock to a definite service, and this point required attention in the design of locomotives and motor coaches As a case in point, he mentioned that the Brighton Railway used their suburban stock for seaside excursion traffic in the summer, and some method must be devised to give a flexible speed characteristic to the motor. They could not double the number of trains in a terminus by electric traction; in fact, terminal and flat junction working would control the result obtained. He thought with the author that under the present conditions as to cost of energy, money, &c., there was little chance of superseding steam working to any great extent. It was no good providing electric locomotives capable of working 50,000 miles per annum unless traffic conditions called for it; the theoretical locomotive mileage was not always obtainable in goods working. As regarded the latter, the north-east coast was a special case and, on the whole, the chances for fast and goods traffic being worked electrically were not very great.

Mr. J. B. Sparks criticised the suggestion to use two different systems of electrification on the same railway. The remarks as to cost of energy were important, as railways would not be able to purchase at much less than 4d. per unit, as was shown by the huge contracts made by the Chicago railways. He calculated that for main-line working, with a train every 40 minutes, electric working would just pay. The author gave approximately 50 per cent. more train-miles for the electric locomotive, but Kahler gave twice as many miles for the electric locomotive, and it seemed certain that 75 such locomotives would do the work of 100 steam locomotives. American figures gave averages of 28-30,000 miles for electric locomotives per annum, but some of the locomotives on the Pennsylvania line did 54,000 miles per annum.

Dr. S. P. Smith wished the author had given reasons why certain people had adopted electric working; they were certainly not always economic ones. The attraction was not profits, but prevention of losses in some cases. Terminal electrification was not mentioned by the author, although it was bound to come in the same way as suburban electrification. He understood the author to suggest that an electric locomotive to develop 1,100 H.P. at 70 M.P.H. had not been built, and referred him to the Lötschberg locomotives, with two 1,250-H.P. motors. He had gone carefully into the design of this locomotive, substituting two 500-H.P. motors, increasing the size of the driving wheels and the gear ratio, and found no difficulty in obtaining a locomotive to meet the conditions laid down by the author. Some analysis diagrams of steam and electric locomotives by Prof. Dalby showed that only 4 per cent. of the energy of the coal was available for traction purposes in either case, but if the electrical method were employed the coal cost could be halved and a great saving made.

Mr. W. M. Mordey thought the author was rather hard on the electrical engineer, as he wanted cheaper locomotives and cheaper energy, but the speaker doubted whether he was right in attaching so much importance to this. It might be possible to make better use of the energy, as it appeared that the efficiency was only some 18 per cent. Fig. 1 was a strong condemnation of present methods of working railways with frequent stops, and the showing was poor by comparison with the Central London line, for instance, where the reduction of energy losses had been specially studied. Advantage must be taken of inductive effects for starting and regenerative effects must replace brake losses.

Mr. H. M. Sayers said he was glad to see that the author admitted that goods traffic could be dealt with electrically, and was in agreement with other railway authorities in this. As to fast traffic, the speaker could not agree that the position was as hopeless as the author suggested; nearly the whole of the weight of the motor could be utilised for adhesion, and this was a great advance on steam locomotive practice. He believed that electric locomotives to fill the conditions outlined by the author could easily be made if required. The author dealt with present—not future—conditions, a failing common to British railways; much capital expenditure on roads and widenings in the past could have been avoided by electrification. Electrical working induced traffic, and he thought that this would apply even to main-line traffic.

The Author, in replying, said he understood that 48 trains per hour each way would shortly be run on the Metropolitan District line. It was evident that a shunt characteristic was desirable for locomotive working, and that not too much importance should be attached to the additional mileage obtainable from an electric locomotive. He thought it was quite feasible to use two electric traction systems on one railway system for dealing with separate traffics. The figures as to train-miles and cost of steam locomotive working for fast passenger services represented the conditions on the Great Western Railway; the London-Brighton line was a typical case where dense traffic favoured electrical working. It was different where the passenger traffic represented a small percentage of the total. He had not said that an electric locomotive could not be built to meet the conditions outlined; some American locomotives did meet the speed requirements, but the draw-bar pull at starting was so great that it would pull a British train to pieces.

## FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

### Amendments.

AUSTRALIA.—The Commonwealth Customs authorities have decided that railless electric trolley cars are to be dutiable at the rate of 35 per cent. ad val. if of British origin, and at the rate of 40 per cent. ad val. if of foreign origin.

SUDAN.—An Ordinance recently passed, which establishes a Customs tariff for the Sudan, provides that goods not specially mentioned in the tariff (no electrical goods are mentioned) are to be dutiable at the rate of 8 per cent. ad val. Subject to certain regulations goods imported into the Sudan from Egypt are free of duty. The Director of Customs is empowered to fix the values on which duties shall be paid at the above rate, and to consult the principal merchants engaged in the trade for that purpose. The valuations fixed will be published for the information of traders, and no tariff of valuation will remain in force for more than 12 months from the date of its official publication.

NEW ZEALAND.—The Board of Trade have received a copy of a Bill regarding the valuation of goods for import duty purposes, which is to come into force on April 1st next. It provides, among other things, that when any duty is imposed on any goods according to value, such value shall be the fair market value of such goods when sold for cash in the ordinary course of business for home consumption in the principal markets of the country from which exported at the time when they were so exported, with 10 per cent. added to such fair market value. No deduction of any kind will be allowed from this value for any special or sample discount, or because of any special arrangement or on account of any other consideration by which a special reduction in price has been, or might be, obtained. If any import duty, or excise duty, has been actually paid, or is payable, on the goods in the country of export, the amount of that duty may be deducted from the fair market value as above determined. For the purpose of determining this value, the importer or his agent shall, on the first entry thereof (other than an entry for removal) produce to the collector or other proper officer the invoice for those goods, and make a declaration in the prescribed form verifying that invoice, and setting out the true value of the goods for the purposes of duty, and such other particulars as may be prescribed. If a failure to produce the invoice is accounted for to the satisfaction of the collector or other proper officer, proof of its contents by a copy, or otherwise, may be received in lieu of its production.

The "invoice" referred to is defined as follows:—

(*a*) In the case of goods imported on the sale thereof the original invoice prepared and issued by or on behalf of the seller showing the true description of the goods and the actual money price paid, or to be paid, for the goods by the purchaser; or

(*b*) In the case of goods consigned for sale in New Zealand, or otherwise than on the sale thereof, the original invoice prepared and issued by the consignor showing the true description of the goods and the fair market value thereof in the principal markets of the country whence they were exported at the date of exportation thereof.

With regard to the valuation of goods by the collector, it is prescribed that the amount of the invoice, after deducting therefrom all reasonable and lawful deductions in respect of discount, freight, insurance and other charges, may be accepted by the collector as sufficient proof of the fair market value of the goods for purposes of duty, and he may value the goods and assess the duty accordingly. If the importer satisfies the collector that the fair market value of the goods for purposes of duty is less than the value as shown by the said invoice after making such deductions as aforesaid, the collector shall value the goods at such lesser sum accordingly, and shall assess the duty on that value. If the collector has reason to believe or suspect that the fair market value of the goods for purposes of duty is greater than the amount of the said invoice after making such deductions as aforesaid, he may value the goods at such higher sum as he thinks proper, and assess the duty on that value accordingly.

## NEW PATENTS APPLIED FOR, 1914.

### (NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

2,672. "Electric wiring system." A. H. MORSE and C. S. PERSICHETTI. February 2nd.

2,679. "Methods of controlling distant apparatus by Hertzian waves." J. H. HAMMOND, Jun. February 2nd. (Addition 13,310/13). (Complete).

2,684. "Telephone writing-attachments." W. W. LOWER. February 2nd.

2,691. "Apparatus for controlling motors from a distance." A. MOND. February 2nd. (Maschinenfabrik Oerhkon, Switzerland). (Complete).

2,693. "Automatic switches." WESTERN ELECTRIC CO., LTD. February 2nd. (F. T. Woodward, Belgium). (Complete).

2,713. "Globe holders for electric, gas, and other lamps." J. A. SHAW. February 2nd. (Complete).

2,737. "Arc lamps." C. C. HUGHES. February 2nd. (Complete).

2,738. "Transmission of wireless signals." R. C. GALLETTI. February 2nd.

2,739. "Electric dischargers." R. C. GALLETTI and R. MANZETTI. February 2nd. (Complete).

2,740. "Method of producing electric impulsive discharges." R. C. GALLETTI. February 2nd. (Complete).

2,741. "Signalling-apparatus." SOC. D'ELECTRICITE MORS. February 2nd. (Convention date, February 3rd, 1913, France). (Complete).

2,744. "Electric mine lamp." J. BOLTON and J. W. RIGBY. February 2nd.

2,793. "Electric cooking and boiling utensils." F. BARRON. February 3rd.

2,795. "Telephone or like apparatus and telephone systems." W. K. L. DICKSON. February 3rd.

2,808. "Electric bells." W. M. THORNTON. February 3rd.

2,815. "Devices for obtaining Rontgen-ray images." G. BUCKY. February 3rd. (Convention date, February 5th, 1913, Germany). (Complete).

2,822. "Conversion or transmission of electric current." A. SCHERBIUS. February 3rd. (Addition to 24,306/13. Convention date, February 3rd, 1913, Germany). (Complete).

2,827. "Electric train-lighting, ventilating, and heating systems and the like." STONE & CO., LTD. and A. H. DARKER. February 3rd. (Complete).

2,837. "Means for increasing the efficiency of electric incandescent lamps." O. L. PEARD. February 3rd.

2,843. "Electric incandescent lamps." F. LOEWENSTEIN. February 3rd (Complete).

2,844. "Devices for amplifying feeble impulses of electric energy." W. L. RICHARDS. February 3rd. (Convention date, February 8th, 1913, United States). (Complete).

2,849. "Electrical insulators." K. VON KANDO. February 3rd. (Complete).

2,850. "Electrolytic meters." BRITISH THOMSON-HOUSTON CO., LTD. February 3rd. (General Electric Co., United States). (Complete).

2,870. "Earthenware tiles and the like." C. E. MORRIS. February 4th.

2,871. "Earthenware troughs for electric cables." C. E. MORRIS. February 4th.

2,872. "Earthenware troughs for electric cables." C. E. MORRIS. February 4th.

2,903. "Automatic electric switches." A. THODE & CO. February 4th. (Convention date, February 5th, 1913, Germany). (Complete).

2,924. "System of synchronising electric clocks." C. E. O'KEENAN. February 4th. (Addition to 23,570/13. Convention date, February 5th, 1913, France). (Complete).

2,935. "Crystal detectors for wireless telegraphy." A. L. CHAUDET. February 4th. (Convention date, March 27th, 1913, Belgium). (Complete).

2,940. "Connectors for wires adapted to convey electric currents." D. N. MILESTONE. February 4th.

2,959. "Electric locomotives." BRITISH THOMSON-HOUSTON CO., LTD. February 4th. (General Electric Co., United States).

3,000. "Electrical battery connectors." C. W. READ. February 5th. (Complete).

3,004. "Electric releasing device for drawing-off apparatus composed of a plurality of weighing and measuring devices and intended for use in connection with goods-packing machines." FR. HESSER MASCHINENFABRIK AKT. GES. February 5th. (Convention date, March 7th, 1913, Germany). (Complete).

3,011. "Electric switches." H. LUCAS and W. H. EDWARDS. February 5th.

3,013. "Electrical-distributing systems." C. VERNIER. February 5th.

3,020. "Magnetic tachometers." W. BECKMANN. February 5th. (Convention date, March 15th, 1913, Germany). (Complete).

3,021. "Eddy-current speed indicators." W. BECKMANN. February 5th. (Convention date, April 14th, 1913, Germany). (Complete).

3,035. "Electro-plating process." C. J. CHARLTON. February 5th.

3,036. "Electric battery." C. J. CHARLTON. February 5th.

3,055. "Electro-motor starters." T S. HILL. February 5th.

3,056. "Indicating devices for electrical tail-lights of motor cars." A. W. BROWN. February 5th.

3,057. "Dynamo-electric machines." J. L. M. YARDLEY. February 5th. (Convention date, March 28th, 1913, United States). (Complete).

3,061. "Electric pocket lamps." W. KRAFFT. February 5th.

3,080. "Wireless telegraphy." A. T. M. JOHNSON, F. H. VARLEY, and A. C. N. TRY. February 5th.

3,086. "Igniting device for explosion engines." G. NAGEL AND UNIONWERK MEA GES.M.B.H. February 5th. (Complete).

3,104. "Ignition apparatus for internal-combustion engines." W. LOFTHOUSE. February 6th.

3,149. "Electrical regulators." F. W. MERRILL. February 6th. (Complete).

3,150. "High-air-tension electrical insulators." A. WATKINS. February 6th. (Complete).

3,169. "Arrangement of electric valves." A. SCHERBIUS. February 6th. (Convention date, February 7th, 1913, Germany). (Complete).

3,171. "Method of periodically modifying high-frequency electric currents." E. VON LEPEL. February 6th. (Convention date, February 11th, 1913, Germany). (Complete).

3,181. "Electro-chemical treatment of liquids." C. P. LANDRETH. February 6th. (Convention date, February 21st, 1913, United States). (Complete).

3,191. "Radio-telegraphic and radio-telephonic receiving systems." G. O. SQUIER. February 6th.

3,192. "Radio-telegraphic stations." E. GIRARDEAU. February 6th. (Convention date, February 17th, 1913, Belgium). (Complete).

3,195. "Telephone systems." AUTOMATIC TELEPHONE MANUFACTURING CO., LTD. and J. SAVIN. February 6th.

3,197. "Method of and means for equalising the potentials of grounding points." A. B. CLARK. February 6th. (Convention date, October 29th, 1913, United States). (Complete).

3,209. "Manufacture of incandescent electric lamps:" C. GLADITZ. February 6th.

3,217. "Locks for handles for controllers and the like." BRITISH THOMSON-HOUSTON CO., LTD. February 6th. (General Electric Co., United States).

3,221. "Electric heaters or resistance elements therefor." J. R. QUAIN. February 6th.

3,232. "Frequency transformers." W. P. THOMPSON. February 7th. (R. Goldschmidt, Germany). (Complete).

3,236. "Electrical influence machines." V. E. JOHNSON. February 7th.

3,237. "Switches." W. DUDDELL and J. S. HIGHFIELD. February 7th.

3,240. "Sparking-plugs for internal-combustion engines." ELECTRIC IGNITION CO. (1913), LTD., and A. COX. February 7th.

3,241 "Electric welding systems." LIVERPOOL ELECTRIC WELDING CO., LTD., and W. A. M. WACHSMUTH. February 7th.

3,254. "Electric heating elements." W. H. STURGE. February 7th.

3,282. "Telephone receiver." J. PARR. February 7th.

3,291. "Single- or multi-phase electric furnace for treating molten metal." P. LESCURE. February 7th. (Convention date, February 7th, 1913, Germany). (Complete).

3,295. "Motor-car starting and lighting sets." H. C. E. JACOBY. February 7th.

3,310. "Synchronising devices for electric motors or other rotating electric machines." R. P. HOWGRAVE-GRAHAM. February 7th.

3,311. "Protection of electric circuits against the influence of alternating currents." K. VON KANDO. February 7th.

## PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & CO., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

### 1912.

23,417. ELECTRICAL TOKEN APPARATUS FOR RAILWAYS. A. T. Blackall & C. M. Jacobs. October 14th.

23,689. TURBO-ELECTRIC MACHINES. A. Rolfe. October 17th.

### 1913.

1,442. SUPPORTS FOR THE FILAMENTS OF INCANDESCENT ELECTRIC LAMPS. J. M. Roux & J. Sanchez. January 17th.

1,467. "DIMMERS" FOR ELECTRIC LAMPS. E. T. Middlemiss. January 18th.

1,591. ELECTRIC MOTOR CONTROL SYSTEMS. Siemens Bros. Dynamo Works, Ltd., F. Lydall and A. M. Duke. January 20th.

1,617. WINDING MACHINES. Western Electric Co. (Western Electric Co.). January 20th.

1,678. APPARATUS FOR HEATING WATER. V. S. Needham & F. G. Needham. January 21st.

1,902. TELEPHONE-EXCHANGE SYSTEMS. Western Electric Co. (Woodward, acting for Western Electric Co.). January 23rd.

1,939. OSCILLATION GAPS OR DISCHARGERS, FOR USE IN RADIO-TELEPHONY, RADIO-TELEGRAPHY, AND LIKE PURPOSES. W. Torikata, E. Yokoyama, M. Kitamura. January 23rd.

1,964. RAILWAY SIGNALLING APPARATUS FOR USE AT PLACES WHERE SPEED RESTRICTIONS OBTAIN. J. N. C. Kennedy. January 24th.

2,198. DEVICES FOR CLOSING AND DISINFECTING TELEPHONE MOUTH-PIECES AND OTHER ARTICLES. M. Dickinson. January 27th.

3,829. LATTICE, MASTS, POLES, TOWERS, AND COLUMNS FOR WIRELESS TELEGRAPHY STATIONS, TRANSMISSION LINES, WINDMILLS, AND THE LIKE. B. C. Barton & P. C. Barton, & Robert W. Blackwell & Co. February 14th.

6,226. RHEOSTATS FOR CONTROLLING ELECTRIC MOTORS AND THE LIKE. P. S. Swan. March 13th.

7,376. TELEPHONE CALL REGISTERS. A. Sterry. March 28th.

7,656. INSULATORS FOR HIGH-TENSION OIL-IMMERSED ELECTRICAL APPARATUS. A. Bitter & E. Weissberg. April 1st.

10,841. METHOD OF OPERATING ROTARY CONVERTERS AND OTHER ALTERNATING CURRENT MACHINERY. A. H. Railing & C. C. Garrard. May 8th.

11,135. APPARATUS FOR AUTOMATICALLY STARTING OR BRAKING ELECTRIC-MOTORS. H. Delvenne. May 10th.

11,991. METALLIC VAPOUR ELECTRIC LAMP. F. Kerschbaum. May 22nd. (January 8th, 1913).

12,377. MANUFACTURE OF STABLE BORON NITRIDE. British Thomson-Houston Co. (General Electric Co.). May 27th.

14,122. ARRANGEMENTS FOR CONVERTING CONTINUOUS CURRENTS OF ELECTRICITY INTO ISOCHRONOUS UNDULATORY CURRENTS. Soc. des Telegraphes Multiplex (Systeme E. Mercadier H. Magunna). June 18th. (June 21st, 1912).

15,571. CONTROLLING MEANS FOR ELECTRIC MOTORS. Otis Elevator Co. (Otis Elevator Co.). July 5th.

16,267. TELEPHONE EXCHANGE SYSTEMS. Western Electric Co. (F. T. Woodward, acting for Western Electric Co.). July 15th. (Divided Application on INTO ISOCHRONOUS UNDULATORY CURRENTS. Soc. des Telegraphes Multiplex

16,481. PROCESS OF MANUFACTURING AN ELECTRIC LAMP FILAMENT CONTAINING COBALT. C. Kanazawa. July 17th. (July 17th, 1912).

21,758. ELECTRIC SIGNALLING APPARATUS FOR SHIP'S TELEGRAPHS AND THE LIKE PURPOSES. H. L. Stocks. September 26th.

22,159. INDUCTION COILS. A. Hiorth. October 1st. (November 30th, 1912).